INTERNAL PERMITTING DOCUMENT TRACKING MANIFEST

Company Name **MarkWest Liberty Midstream & Resources**

Permitting Action Number R13-2818G Total Days 62 DAQ Days 27

Permitting Action:

- ○ Permit Determination
- ○ General Permit
- ○ Administrative Update
- ○ Temporary
- ○ Relocation
- ○ Construction
- ☑ Modification
- ○ PSD (Rule 14)
- ○ NNSR (Rule 19)

Documents Attached:

- ☑ Engineering Evaluation/Memo
- ☑ Draft Permit
- ☑ Notice
- ○ Denial
- ○ Final Permit/General Permit Registration
- ○ Completed Database Sheet
- ○ Withdrawal
- ○ Letter
- ○ Other *(specify)*_____

Date	From	To	Action Requested
2/8/2017	Jerry JF	Bev	Please review and approve for notice
2/15	Bev	Jerry	Go to Notice
2/15	Jerry	Sandie	Approved for Notice

NOTE: Retain a copy of this manifest for your records when transmitting your document(s).

Engineer	Jerry Williams, P.E.
Email Address	jerry.williams@wv.gov
Company Name	MarkWest Liberty Midstream & Resources L.L.C.
Company ID	051-000125
Facility Name	Majorsville Gas Plant
Permit Number	R13-2818G
County	Marshall
Newspaper	*Moundsville Daily Echo*
Company Email and "Attention To:"	Leanne Meyer lmeyer@markwest.com
Environmental Contact Email Address	Wade Janecek wade.janecek@markwest.com
Regional Office (if applicable)	NPRO
New or Modified Source?	modified
Construction, Modification, or Relocation?	modification
Type of Facility	natural gas processing facility
"Located" or "To Be Located"?	located
Place where I can find electronic versions of your notice, engineering evaluation, and draft permit	Q:\AIR_QUALITY\J_Willi\Permit Applications Under Review\MarkWest Liberty Midstream & Resources, LLC\R13-2818G Majorsville

AIR QUALITY PERMIT NOTICE

Notice of Intent to Approve

On December 8, 2016, MarkWest Liberty Midstream & Resources, LLC applied to the WV Department of Environmental Protection, Division of Air Quality (DAQ) for a permit to modify a natural gas processing facility (Majorsville Gas Plant) located at 1700 Majorsville Road, Majorsville, Marshall County, WV at latitude 39.963611 and longitude -80.520556. A preliminary evaluation has determined that all State and Federal air quality requirements will be met by the proposed facility. The DAQ is providing notice to the public of its preliminary determination to issue the permit as R13-2818G.

The following increase in potential emissions will be authorized by this permit action: Particulate Matter less than 10 microns, 0.76 tons per year (TPY); Sulfur Dioxide, 0.98 TPY; Oxides of Nitrogen, 16.75 TPY; Carbon Monoxide, 20.66 TPY; Total Hazardous Air Pollutants, 0.33 TPY; Formaldehyde, 0.05 TPY; Carbon Dioxide Equivalents, 69,924 TPY.

The following decrease in potential emissions will be authorized by this permit action: Volatile Organic Compounds, 0.75 TPY.

Written comments or requests for a public meeting must be received by the DAQ before 5:00 p.m. on (Day of Week, Month, Day, Year). A public meeting may be held if the Director of the DAQ determines that significant public interest has been expressed, in writing, or when the Director deems it appropriate.

The purpose of the DAQ's permitting process is to make a preliminary determination if the proposed modification will meet all state and federal air quality requirements. The purpose of the public review process is to accept public comments on air quality issues relevant to this determination. Only written comments received at the address noted below within the specified time frame, or comments presented orally at a scheduled public meeting, will be considered prior to final action on the permit. All such comments will become part of the public record.

Jerry Williams, P.E.
WV Department of Environmental Protection
Division of Air Quality
601 57th Street, SE
Charleston, WV 25304
Telephone: 304/926-0499, ext. 1223
FAX: 304/926-0478

Additional information, including copies of the draft permit, application and all other supporting materials relevant to the permit decision may be obtained by contacting the engineer listed above. The draft permit and engineering evaluation can be downloaded at:

www.dep.wv.gov/daq/Pages/NSRPermitsforReview.aspx

west virginia department of environmental protection

Division of Air Quality
601 57th Street SE
Charleston, WV 25304
Phone (304) 926-0475 • FAX: (304) 926-0479

Jim Justice, Governor
Austin Caperton, Cabinet Secretary
www.dep.wv.gov

ENGINEERING EVALUATION / FACT SHEET

BACKGROUND INFORMATION

Application No.:	R13-2818G
Plant ID No.:	051-00125
Applicant:	MarkWest Liberty Midstream & Resources L.L.C. (MarkWest)
Facility Name:	Majorsville Gas Plant
Location:	Majorsville, Marshall County
NAICS Code:	211112
SIC Code:	1321
Application Type:	Modification
Received Date:	December 8, 2016
Engineer Assigned:	Jerry Williams, P.E.
Fee Amount:	$2,000.00
Date Received:	December 8, 2016
Complete Date:	January 12, 2017
Due Date:	April 12, 2017
Applicant Ad Date:	December 12, 2016
Newspaper:	*Wheeling Intelligencer*
UTM's:	Easting: 540.947 km Northing: 4,423.83 km Zone: 17
Description:	Modification application to construct one (1) new depropanizer tower (cryogenic plant) to remove liquids from the gas stream. An additional deethanizer will be constructed to remove ethane from the residual natural gas.

DESCRIPTION OF PROCESS

The following process description was taken from Permit Application R13-2818G:

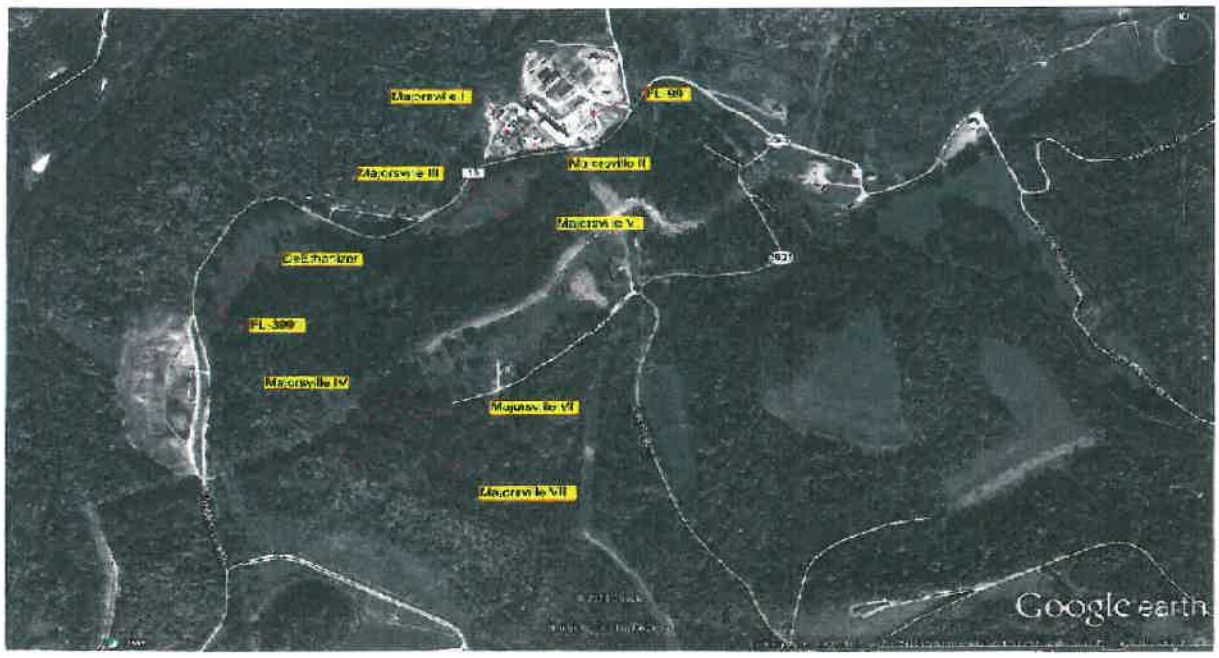
MarkWest proposes to construct additional processing capability at the natural gas processing plant at the Majorsville site. The processing capability will consist of adding one (1) natural gas processing plant (Majorsville VII) with a maximum capacity of 230 million standard cubic feet per day (mmscfd). One (1) stabilization unit will be installed to remove carryover methane and ethane from the natural gas liquids. The plant will be installed with appropriate electric compressor engines, and heaters.

The Majorsville Processing Plant is used as a gathering station for gas wells throughout southwest Pennsylvania and West Virginia. Upon entering the plant the gas goes through a mol sieve which is designed to remove liquids from the gas stream. Heaters are used to regenerate the mol sieve on a regular basis to remove the water and hydrocarbons. After the mol sieve, the gas will be cooled through a cryogenic plant with mechanical refrigeration which serves to remove propane and heavier hydrocarbons in the gas stream. The natural gas liquids from the new plant will then pass through a stabilizer to remove any carryover methane and ethane in the liquid stream. The remaining gas stream (mostly methane and ethane) will pass through the deethanizers, so that ethane can be separated and recovered from the gas stream. The ethane will then be transferred via pipeline to market. The remaining natural gas will pass through the existing compressor engines of one of the electric driven engines prior to entering the downstream pipeline to market. Electric pumps will be located on site to transfer the recovered liquids to another facility for disposal or further processing.

SITE INSPECTION

The facility was last inspected on May 17, 2016 by Angela Carey of the DAQs Northern Panhandle Regional Office. The facility was found to be in compliance.

Latitude: 39.963611
Longitude: -80.520556



ESTIMATE OF EMISSIONS BY REVIEWING ENGINEER

Emissions associated with this modification application consist of the emissions from four (4) heaters (17E, 19E, 23E, 24E), four (4) emergency generators (28E, 29E, 32E, 33E), and one (1) methanol tank (40E).

Fugitive emissions for the facility are based on calculation methodologies presented in EPA Protocol for Equipment Leak Emission Estimates and TCEQ Air Permit Technical Guidance. The following table indicates which methodology was used in the emissions determination:

Emission Unit ID#	**Emission Point ID#**	**Process Equipment**	**Calculation Methodology**
H-7741	17E	7.69 MMBTU/hr Regeneration Heater	EPA AP-42 Emission Factors
H-7781	19E	16.07 MMBTU/hr Hot Medium Oil Heater	EPA AP-42 Emission Factors
H-D2782	23E	119.2 MMBTU/hr DEethanizer Hot Medium Oil Heater	EPA AP-42 Emission Factors
H-D2741	24E	14.25 MMBTU/hr DeEthanizer Regen Heater	EPA AP-42 Emission Factors
M7-G-8	28E	145 hp Emergency Generator	EPA AP-42 Emission Factors / Vendor Data
M7-G-9	29E	145 hp Emergency Generator	EPA AP-42 Emission Factors / Vendor Data
MD2-G-10	32E	53 hp Emergency Generator	EPA AP-42 Emission Factors / Vendor Data
MD2-G-11	33E	32 hp Emergency Generator	EPA AP-42 Emission Factors / Vendor Data
MT-7	40E	520 gal Methanol Storage Tank	Negligible emissions

The total PTE after this proposed modification (including fugitives) is shown in the following table:

Pollutant	**Maximum Pre-Modification Annual Facility Wide Emissions (tons/year)**	**Maximum Post-Modification Annual Facility Wide Emissions (tons/year)**	**Net Facility Wide Emissions Changes (tons/year)**
Nitrogen Oxides	97.31	114.06	16.75
Carbon Monoxide	78.49	99.15	20.66
Volatile Organic Compounds	79.79	79.04	-0.75
Particulate Matter-10/2.5	7.87	8.63	0.76
Sulfur Dioxide	1.10	2.08	0.98
Total HAPs	12.74	13.07	0.33
Formaldehyde	5.58	5.63	0.05
Greenhouse Gas (CO_2e)	182,719	252,643	69,924

Maximum detailed controlled point source emissions were calculated by MarkWest and checked for accuracy by the writer and are summarized in the table on the next page.

MarkWest Liberty Midstream & Resources, L.L.C – Majorsville Gas Plant (R13-2818G)

Emission	Source	NO_x		CO		VOC		PM-10/2.5		SO_2		Total HAPs		Formaldehyde		CO_2e
Point ID#		lb/hr	ton/year	lb/hr	ton/year	lb/hr	ton/year	lb/hr	ton/year	lb/hr	ton/year	lb/hr	ton/year	lb/hr	ton/year	ton/year
2E	2,370 hp Compressor Engine	2.61	11.44	0.99	4.35	2.09	9.15	0.16	0.69	0.01	0.04	0.72	3.17	0.42	1.83	9114
3E	2,370 hp Compressor Engine	2.61	11.44	0.99	4.35	2.09	9.15	0.16	0.69	0.01	0.04	0.72	3.17	0.42	1.83	9114
4E	2,370 hp Compressor Engine	2.61	11.44	0.99	4.35	2.09	9.15	0.16	0.69	0.01	0.04	0.72	3.17	0.42	1.83	9114
5E	5.6 MMBTU/hr Heater	0.30	1.32	0.46	2.02	0.03	0.13	0.04	0.18	<0.01	0.01	0.01	0.05	<0.01	<0.01	3157
6E	15.4 MMBTU/hr Heater	1.34	5.85	1.27	5.56	0.08	0.36	0.11	0.50	<0.01	0.04	0.03	0.13	<0.01	<0.01	8681
9E	5.6 MMBTU/hr Heater	0.30	1.32	0.46	2.02	0.03	0.13	0.04	0.18	<0.01	0.01	0.01	0.05	<0.01	<0.01	3157
10E	7.69 MMBTU/hr Regen III Heater	0.41	1.80	0.32	1.38	0.04	0.18	0.06	0.25	<0.01	0.02	0.01	0.06	<0.01	<0.01	4335
11E	7.69 MMBTU/hr Regen IV Heater	0.41	1.80	0.32	1.38	0.04	0.18	0.06	0.25	<0.01	0.02	0.01	0.06	<0.01	<0.01	4335
12E	16.07 MMBTU/hr HMO III Heater	1.61	7.04	1.32	5.80	0.09	0.38	0.03	0.13	<0.01	0.04	0.03	0.13	<0.01	<0.01	9059
13E	119.2 MMBTU/hr HMO I Heater	3.58	15.66	4.77	20.88	0.64	2.82	0.22	0.97	0.07	0.31	0.22	0.97	<0.01	0.04	67195
14E	14.25 MMBTU/hr Regen I Heater	0.57	2.50	0.58	2.56	0.27	1.19	0.19	0.81	0.01	0.04	0.03	0.11	<0.01	<0.01	8033
15E	7.69 MMBTU/hr Regen V Heater	0.41	1.80	0.32	1.38	0.04	0.18	0.06	0.25	<0.01	0.02	0.01	0.06	<0.01	<0.01	4335
16E	7.69 MMBTU/hr Regen VI Heater	0.41	1.80	0.32	1.38	0.04	0.18	0.06	0.25	<0.01	0.02	0.01	0.06	<0.01	<0.01	4335
17E	7.69 MMBTU/hr Regen VII Heater	0.41	1.80	0.32	1.38	0.04	0.18	0.06	0.25	<0.01	0.02	0.01	0.06	<0.01	<0.01	4335
18E	16.07 MMBTU/hr HMO IV Heater	1.61	7.04	1.32	5.80	0.09	0.38	0.03	0.13	<0.01	0.04	0.03	0.13	<0.01	<0.01	9059
19E	16.07 MMBTU/hr HMO VII Heater	1.61	7.04	1.32	5.80	0.09	0.38	0.03	0.13	<0.01	0.04	0.03	0.13	<0.01	<0.01	9059
20E	10.65 MMBTU/hr Stabilization Heater	0.63	2.74	0.88	3.84	0.06	0.25	0.02	0.09	<0.01	0.03	0.02	0.09	<0.01	<0.01	6005
21E	254 hp I & II Emergency Generator	1.12	0.28	1.68	0.42	0.56	0.14	0.02	0.01	<0.01	<0.01	0.04	0.01	<0.01	<0.01	61
22E	145 hp III Emergency Generator	0.70	0.18	0.18	0.04	0.02	<0.01	0.23	0.06	0.58	0.14	0.01	<0.01	<0.01	<0.01	157
23E	119.2 MMBTU/hr HMO II Heater	3.58	15.66	4.77	20.88	0.64	2.82	0.22	0.97	0.07	0.31	0.22	0.97	<0.01	0.04	67195
24E	14.25 MMBTU/hr Regen II Heater	0.57	2.50	0.58	2.56	0.27	1.19	0.19	0.81	0.01	0.04	0.03	0.11	<0.01	<0.01	8033
25E	145 hp III Emergency Generator	0.70	0.18	0.18	0.04	0.02	<0.01	0.23	0.06	0.58	0.14	0.01	<0.01	<0.01	<0.01	157
26E	145 hp IV Emergency Generator	0.70	0.18	0.18	0.04	0.02	<0.01	0.23	0.06	0.58	0.14	0.01	<0.01	<0.01	<0.01	157
27E	145 hp IV Emergency Generator	0.70	0.18	0.18	0.04	0.02	<0.01	0.23	0.06	0.58	0.14	0.01	<0.01	<0.01	<0.01	157
28E	145 hp VII Emergency Generator	0.70	0.18	0.18	0.04	0.02	<0.01	0.23	0.06	0.58	0.14	0.01	<0.01	<0.01	<0.01	157
29E	145 hp VII Emergency Generator	0.70	0.18	0.18	0.04	0.02	<0.01	0.23	0.06	0.58	0.14	0.01	<0.01	<0.01	<0.01	157
30E	53 hp I Emergency Generator	0.41	0.10	0.43	0.11	0.41	0.10	<0.01	<0.01	0.11	0.03	<0.01	<0.01	<0.01	<0.01	17
31E	32 hp I Emergency Generator	0.25	0.06	0.29	0.07	0.25	0.06	<0.01	<0.01	0.07	0.02	<0.01	<0.01	<0.01	<0.01	10
32E	53 hp II Emergency Generator	0.41	0.10	0.43	0.11	0.41	0.10	<0.01	<0.01	0.11	0.03	<0.01	<0.01	<0.01	<0.01	17
33E	32 hp II Emergency Generator	0.25	0.06	0.29	0.07	0.25	0.06	<0.01	<0.01	0.07	0.02	<0.01	<0.01	<0.01	<0.01	10
FL-991	3.7 mmscf/hr Flare	0.05	0.22	0.04	0.18	<0.01	0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	287
FL-1991	3.7 mmscf/hr Flare IV, VI, VII	0.49	0.20	2.47	0.26	<0.01	0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	240
PIG	Pigging Emissions	0	0	0	0	NA	0.15	0	0	0	0	0	0	NA	0.01	12
BD	Blowdown Emissions	0	0	0	0	0.40	1.75	0	0	0	0	0	0	NA	0.08	2841
TANKS	Pressurized Vessels	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Flare emissions are those emissions that exist under routine/planned activities.																
Total Point Source Emissions		**32.76**	**114.06**	**29.01**	**99.15**	**11.14**	**40.66**	**3.29**	**8.63**	**4.07**	**2.08**	**3.04**	**12.78**	**1.32**	**5.63**	**252089**
7E	Fugitive Equiment Leaks	0	0	0	0	8.76	38.38	0	0	0	0	NA	0.29	0	0	553
Total Fugitive Emissions		0.00	0.00	0.00	0.00	8.76	38.38	0.00	0.00	0.00	0.00	0.07	0.29	0.00	0.00	553
Facility Wide Emissions		**32.76**	**114.06**	**29.01**	**99.15**	**19.90**	**79.04**	**3.29**	**8.63**	**4.07**	**2.08**	**3.11**	**13.07**	**1.32**	**5.63**	**252643**

REGULATORY APPLICABILITY

The following rules apply to this modification:

45CSR2 (Particulate Air Pollution from Combustion of Fuel in Indirect Heat Exchangers)

The purpose of 45CSR2 (Particulate Air Pollution from Combustion of Fuel in Indirect Heat Exchangers) is to establish emission limitations for smoke and particulate matter which are discharged from fuel burning units.

The existing gas plant and proposed changes calls for the use of heaters. Boilers or indirect heat exchangers are affected units under 45CSR2 and 40CFR60 Subpart Dc. However, a process heater that is primarily used to heat a material to initiate or promote a chemical reaction in which the materials participates as a reactant or catalyst are excluded as affected units under these rules.

MarkWest claims that the mole sieve regeneration heaters (H-D2741 and H-7741) and heaters for the de-ethanization unit (H-D2782 and H-7781) are process heaters and are excluded from these rules and regulations.

The mole sieve regeneration heaters use an adsorbent to dehydrate the wet gas prior to processing. Once the adsorbent is saturated with water, the mole sieve adsorbent must be regenerated. The regeneration heaters are used to provide process heat to regenerate the adsorbent, which could be considered as a catalyst bed. Therefore, the mole sieve regeneration heaters are excluded from 45CSR2.

The purpose of the de-ethanization heater is to supply heat for the de-ethanization process which prepares purity ethane to go to market by removing it from the mixed natural gas liquid stream and removing CO_2 to meet pipeline specifications. Therefore, these heaters are heating a heat transfer medium that participates in a chemical reaction in the Amine Still of the de-ethanization unit and are not affected units under 45CSR2.

45CSR10 (To Prevent and Control Air Pollution from the Emissions of Sulfur Oxides)

The purpose of this rule is to establish standards for emissions of sulfur oxides from fuel burning units, manufacturing operations and combustion of refinery or process gas streams.

45CSR10 has the same definition of "process heater" as 45CSR2, and 40CFR60 Subparts Db & Dc. Therefore, the heaters that meet the definition of "process heater" are not considered as fuel burning units (boilers) in this rule. However, the heaters are considered part of a manufacturing process (45 CSR §10-2.11.) because they are equipment used in connection with the process. These heaters (H-D2741, H-7741, H-D2782, H-7781) are subject to the 2,000 ppm sulfur dioxide allowable in 45 CSR §10-4.1. The proposed SO_2 emissions from these units are negligible.

45CSR13 (Permits for Construction, Modification, Relocation and Operation of Stationary Sources of Air Pollutants, Notification Requirements, Administrative Updates, Temporary Permits, General Permits, and Procedures for Evaluation)

45CSR13 applies to this source because MarkWest's proposed modification exceeds the regulatory emission threshold for criteria pollutants of 6 lb/hr and 10 ton/year, and they are also subject to a substantive requirement of an emission control rule promulgated by the Secretary (40CFR60 Subpart IIII, OOOO and OOOOa).

MarkWest paid the appropriate application fee and published the required legal advertisement for this modification application.

45CSR16 (Standards of Performance for New Stationary Sources Pursuant to 40 CFR Part 60)

45CSR16 applies to this facility by reference of 40CFR60, Subparts KKK, IIII, OOOO and OOOOa.

45CSR30 (Requirements for Operating Permits)

MarkWest is a major source subject to 45CSR30 due to their nitrogen oxides (NO_x) emissions exceeding major source thresholds. As a result of the granting of this permit, the source is subject to 45CSR30. The Title V (45CSR30) application will be due within twelve (12) months after the date of the commencement of the operation or activity (activities) authorized by this permit.

40CFR60 Subpart IIII (Standards of Performance for Stationary Compression Ignition Internal Combustion Engines (CI ICE))

The 145 hp diesel fired generators (M7-G-8, M7-G-9) are USEPA certified stationary compression ignition engines according to 40CFR60 Subpart IIII.

The 53 hp diesel fired generator (MD2-G-10) is an USEPA certified stationary compression ignition engine according to 40CFR60 Subpart IIII.

The 32 hp diesel fired generator (MD2-G-11) is an USEPA certified stationary compression ignition engine according to 40CFR60 Subpart IIII.

Therefore, MarkWest will not be required to conduct an initial performance test and conduct subsequent performance testing every 8,760 hours or three (3) years, whichever comes first, to demonstrate compliance.

40CFR60 Subpart OOOOa (Standards of Performance for Crude Oil and Natural Gas Production, Transmission and Distribution for which Construction, Modification or Reconstruction Commenced after September 18, 2015)

EPA published its New Source Performance Standards (NSPS) and air toxics rules for the oil and gas sector on August 16, 2012. EPA published amendments to the Subpart on September 23, 2013 and June 3, 2016. 40CFR60 Subpart OOOOa establishes emission

standards and compliance schedules for the control of the pollutant greenhouse gases (GHG). The greenhouse gas standard in this subpart is in the form of a limitation on emissions of methane from affected facilities in the crude oil and natural gas source category that commence construction, modification or reconstruction after September 18, 2015. This subpart also establishes emission standards and compliance schedules for the control of volatile organic compounds (VOC) and sulfur dioxide (SO_2) emissions from affected facilities that commence construction, modification or reconstruction after September 18, 2015. The effective date of this rule is August 2, 2016.

a. Each well affected facility, which is a single natural gas well.

There are no wells at this facility. Therefore, all requirements regarding gas well affected facilities under 40 CFR 60 Subpart OOOOa would not apply.

b. Each centrifugal compressor affected facility, which is a single centrifugal compressor using wet seals that is located between the wellhead and the point of custody transfer to the natural gas transmission and storage segment. For the purposes of this subpart, your centrifugal compressor is considered to have commenced construction on the date the compressor is installed (excluding relocation) at the facility. A centrifugal compressor located at a well site, or an adjacent well site and servicing more than one well site, is not an affected facility under this subpart.

There are no centrifugal compressors at this facility. Therefore, all requirements regarding centrifugal compressors under 40 CFR 60 Subpart OOOOa would not apply.

c. Each reciprocating compressor affected facility, which is a single reciprocating compressor located between the wellhead and the point of custody transfer to the natural gas transmission and storage segment. For the purposes of this subpart, your reciprocating compressor is considered to have commenced construction on the date the compressor is installed (excluding relocation) at the facility. A reciprocating compressor located at a well site, or an adjacent well site and servicing more than one well site, is not an affected facility under this subpart.

There are no modifications to reciprocating internal combustion engines located at this facility after September 18, 2015. Therefore, the requirements regarding reciprocating compressors under 40 CFR 60 Subpart OOOOa would not apply to this permitting action.

d. Pneumatic Controllers

- Each pneumatic controller affected facility, which is a single continuous bleed natural gas-driven pneumatic controller operating at a natural gas bleed rate greater than 6 scfh which commenced construction after August 23, 2011, and is located between the wellhead and the point of custody transfer to the natural gas transmission and storage segment and not located at a natural gas processing plant.

- Each pneumatic controller affected facility, which is a single continuous bleed natural gas-driven pneumatic controller which commenced construction after August 23, 2011, and is located at a natural gas processing plant.

All requirements regarding pneumatic controllers located at a natural gas processing plant under 40 CFR 60 Subpart OOOOa would apply.

e. Each storage vessel affected facility, which is a single storage vessel, located in the oil and natural gas production segment, natural gas processing segment or natural gas transmission and storage segment.

40CFR60 Subpart OOOOa defines a storage vessel as a unit that is constructed primarily of non-earthen materials (such as wood, concrete, steel, fiberglass, or plastic) which provides structural support and is designed to contain an accumulation of liquids or other materials. The following are not considered storage vessels:

- Vessels that are skid-mounted or permanently attached to something that is mobile (such as trucks, railcars, barges or ships), and are intended to be located at a site for less than 180 consecutive days. If the source does not keep or are not able to produce records, as required by §60.5420(c)(5)(iv), showing that the vessel has been located at a site for less than 180 consecutive days, the vessel described herein is considered to be a storage vessel since the original vessel was first located at the site.

- Process vessels such as surge control vessels, bottoms receivers or knockout vessels.

- Pressure vessels designed to operate in excess of 204.9 kilopascals and without emissions to the atmosphere.

The potential for VOC emissions must be calculated using a generally accepted model or calculation methodology, based on the maximum average daily throughput for a 30-day period of production prior to the applicable emission determination deadline specified in this subsection. The determination may take into account requirements under a legally and practically enforceable limit in an operating permit or other requirement established under a federal or state authority. For each storage vessel affected facility that emits more than 6 tpy of VOC, the permittee must reduce VOC emissions by 95% or greater within 60 days of startup.

There are no storage vessel affected facilities constructed after September 18, 2015. Therefore, the requirements regarding storage vessels under 40 CFR 60 Subpart OOOOa would not apply.

f. The group of all equipment, except compressors, within a process unit is an affected facility.

- Addition or replacement of equipment for the purpose of process improvement that is accomplished without a capital expenditure shall not by itself be considered a modification under this subpart.

- Equipment associated with a compressor station, dehydration unit, sweetening unit, underground storage vessel, field gas gathering system, or liquefied natural gas unit is covered by §§60.5400a, 60.5401a, 60.5402a, 60.5421a and 60.5422a of this subpart if it is located at an onshore natural gas processing plant. Equipment not located at the onshore natural gas processing plant site is exempt from the provisions of §§60.5400a, 60.5401a, 60.5402a, 60.5421a and 60.5422a of this subpart.

- The equipment within a process unit of an affected facility located at onshore natural gas processing plants and described in paragraph (f) of this section are exempt from this subpart if they are subject to and controlled according to subparts VVa, GGG or GGGa of this part.

Majorsville VII was constructed after September 18, 2015. Therefore, Leak Detection and Repair (LDAR) requirements for onshore natural gas processing plants would apply to this equipment.

g. Sweetening units located at onshore natural gas processing plants that process natural gas produced from either onshore or offshore wells.

- Each sweetening unit that processes natural gas is an affected facility; and

- Each sweetening unit that processes natural gas followed by a sulfur recovery unit is an affected facility.

- Facilities that have a design capacity less than 2 long tons per day (LT/D) of hydrogen sulfide (H_2S) in the acid gas (expressed as sulfur) are required to comply with recordkeeping and reporting requirements specified in §60.5423a(c) but are not required to comply with §§60.5405a through 60.5407a and paragraphs 60.5410a(g) and 60.5415a(g) of this subpart.

- Sweetening facilities producing acid gas that is completely reinjected into oil-or-gas-bearing geologic strata or that is otherwise not released to the atmosphere are not subject to §§60.5405a through 60.5407a, 60.5410a(g), 60.5415a(g), and 60.5423a of this subpart.

There are no sweetening units at the Majorsville Gas Plant. Therefore, all requirements regarding sweetening units under 40 CFR 60 Subpart OOOOa would not apply.

h. Pneumatic Pumps

There are no pneumatic pump affected facilities constructed after September 18, 2015. Therefore, the requirements regarding pneumatic pumps under 40 CFR 60 Subpart OOOOa would not apply.

i. Collection of fugitive emission components.

Majorsville VII was constructed after September 18, 2015. Therefore, Leak Detection and Repair (LDAR) requirements for onshore natural gas processing plants would apply to this equipment.

40CFR63 Subpart ZZZZ (National Emission Standards for Hazardous Air Pollutants for Reciprocating Internal Combustion Engines)

Subpart ZZZZ establishes national emission limitations and operating limitations for HAPs emitted from stationary RICE located at major and area sources of HAP emissions. This subpart also establishes requirements to demonstrate initial and continuous compliance with the emission limitations and operating limitations. The emergency generators (22E, 23E) at the Majorsville Gas Plant are subject to the area source requirements for non-emergency compression ignition engines.

The applicability requirements for new stationary RICEs located at an area source of HAPs, is the requirement to meet the standards of 40CFR60 Subpart IIII. These requirements were outlined above. The proposed engines meet these standards.

The following rules do not apply to this modification:

40CFR60 Subpart Dc (Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units)

40CFR60 Subpart Dc applies to steam generating units. The rule further defines a steam generating unit as a device that combusts any fuel and produces steam or heats water or any other heat transfer medium. However, this term does not include process heaters as defined in this subpart. Process heater is defined as a device that is primarily used to heat a material to initiate or promote a chemical reaction in which the material participates as a reactant or catalyst. The process heaters at the Majorsville Gas Plant are dedicated to the removal and separation of NGLs from the gas stream. They do no serve any other purpose such as providing steam for the heating of buildings or for co-generation of electric power. Therefore, this rule does not apply to the proposed process heaters.

40CFR60 Subpart KKK (Standards of Performance for Equipment Leaks of VOC from Onshore Natural Gas Processing Plants)

This modification does not affect Subpart KKK applicability. 40CFR60 Subpart KKK applies to onshore natural gas processing plants that commenced construction after January 20, 1984 but before August 23, 2011. The equipment (Majorsville I & II) at the existing Majorsville Gas Plant is currently subject to this rule due to the natural gas

processing facility and this modification does not change that. MarkWest must continue meet the LDAR requirements of Subpart KKK. However, since the new equipment (Majorsville VII) will be constructed after September 18, 2015, it is not subject to Subpart KKK (§60.630(b)). It will, however, be subject to Subpart OOOOa as stated above.

45CSR14 (Permits for Construction and Major Modification of Major Stationary Sources of Air Pollutants)

45CSR19 (Permits for Construction and Major Modification of Major Stationary Sources of Air Pollution which Cause or Contribute to Nonattainment)

On September 30, 2013, EPA approved a redesignation request and State Implementation Plan (SIP) revision submitted by the State of West Virginia. The West Virginia Department of Environmental Protection (WVDEP) requested that the West Virginia portion of the Wheeling, WV–OH fine particulate matter ($PM_{2.5}$) nonattainment area (''Wheeling Area'' or ''Area'') be redesignated as attainment for the 1997 annual $PM_{2.5}$ national ambient air quality standard (NAAQS).

The Majorsville Gas Plant is located in Marshall County, which is located in this metropolitan statistical area and is an attainment county for all pollutants. Therefore, the Majorsville Gas Plant is not subject to 45CSR19.

As shown in the following table, MarkWest is not a major source subject to 45CSR14 or 45CSR19 review. According to 45CSR14 Section 2.43.e, fugitive emissions are not included in the major source determination because it is not listed as one of the source categories in Table 1. Therefore, the fugitive emissions are not included in the PTE below.

Pollutant	**PSD (45CSR14) Threshold (tpy)**	**NANSR (45CSR19) Threshold (tpy)**	**Majorsville PTE (tpy)**	**45CSR14 or 45CSR19 Review Required?**
Carbon Monoxide	250	NA	99.15	No
Nitrogen Oxides	250	NA	114.06	No
Sulfur Dioxide	250	NA	2.08	No
Particulate Matter 2.5	250	NA	8.63	No
Ozone (VOC)	250	NA	40.66	No

TOXICITY OF NON-CRITERIA REGULATED POLLUTANTS

There will be small amounts of various non-criteria regulated pollutants emitted from the combustion of natural gas. However, due to the concentrations emitted, detailed toxicological information is not included in this evaluation.

AIR QUALITY IMPACT ANALYSIS

Modeling was not required of this source due to the fact that the facility is not subject to 45CSR14 (Permits for Construction and Major Modification of Major Stationary Sources of Air Pollutants) as seen in the table listed in the Regulatory Discussion Section.

SOURCE AGGREGATION

"Building, structure, facility, or installation" is defined as all the pollutant emitting activities which belong to the same industrial grouping, are located on one or more contiguous and adjacent properties, and are under the control of the same person.

The Source Determination Rule for the oil and gas industry was published in the Federal Register on June 3, 2016 and became effective on August 2, 2016. EPA defined the term "adjacent" and stated that equipment and activities in the oil and gas sector that are under common control will be considered part of the same source if they are located on the same site or on sites that share equipment and are within ¼ mile of each other.

The Majorsville Gas Plant will operate under the SIC code of 1321 (Natural Gas Liquid Extraction). There are other facilities operated by MarkWest that share the same two-digit major SIC code of 13. However, these facilities are not located on "contiguous or adjacent" property. Therefore, the emissions from this facility shall not be aggregated with other facilities for the purposes of making Title V and PSD determinations.

MONITORING OF OPERATIONS

MarkWest will be required to perform the following monitoring:

1. Monitor and record quantity of natural gas consumed for all combustion sources.
2. Monitor and record quantity of natural gas routed through the process flare.
3. Monitor the presence of the flare pilot flame with a thermocouple or equivalent.
4. Establish a Leak Detection and Repair (LDAR) program for all equipment in VOC or wet gas service according to 40CFR60 Subparts KKK (Majorsville I and II), OOOO (Majorsville III – VI) and OOOOa (Majorsville VII).
5. Monitor and record quantity of constituents transferred from the storage tanks.

MarkWest will be required to perform the following recordkeeping:

1. Maintain records of the amount of natural gas consumed and hours or operation for each heater.
2. Maintain records of the amount of constituents transferred from the storage tanks.
3. Maintain records of the flare design evaluation.
4. Maintain records of testing conducted in accordance with the permit. Said records shall be maintained on-site or in a readily accessible off-site location
5. Maintain the corresponding records specified by the on-going monitoring requirements of and testing requirements of the permit.
6. Maintain records of the visible emission opacity tests conducted per the permit.
7. Maintain a record of all potential to emit (PTE) HAP calculations for the entire facility. These records shall include the natural gas compressor engines and ancillary equipment.
8. The records shall be maintained on site or in a readily available off-site location maintained by MarkWest for a period of five (5) years.

CHANGES TO PERMIT R13-2818F

R13-2818G will supersede and replace R13-2818F that was issued on June 19, 2014.

MarkWest proposes to construct additional processing capability at the natural gas processing plant at the Majorsville site. The processing capability will consist of adding one (1) natural gas processing plant (Majorsville VII) with a maximum capacity of 230 million standard cubic feet per day (mmscfd). One (1) stabilization unit will be installed to remove carryover methane and ethane from the natural gas liquids. The equipment added consists of four (4) heaters (17E, 19E, 23E, 24E), four (4) emergency generators (28E, 29E, 32E, 33E), and one (1) methanol tank (40E).

RECOMMENDATION TO DIRECTOR

The information provided in the permit application indicates that MarkWest meets all the requirements of applicable regulations. Therefore, impact on the surrounding area should be minimized and it is recommended that the Majorsville Gas Plant should be granted a 45CSR13 modification for their facility.

Jerry Williams, P.E.
Engineer

FEB 08, 2017
Date

West Virginia Department of Environmental Protection

Jim Justice
Governor

Division of Air Quality

Austin Caperton
Cabinet Secretary

Permit to Modify

R13- 2818G

This permit is issued in accordance with the West Virginia Air Pollution Control Act (West Virginia Code §§22-5-1 et seq.) and 45 C.S.R. 13 – Permits for Construction, Modification, Relocation and Operation of Stationary Sources of Air Pollutants, Notification Requirements, Temporary Permits, General Permits and Procedures for Evaluation. The permittee identified at the above-referenced facility is authorized to construct the stationary sources of air pollutants identified herein in accordance with all terms and conditions of this permit.

Issued to:

MarkWest Liberty Midstream & Resources, L.L.C.
Majorsville Gas Plant
051-00125

William F. Durham
Director

Issued: Draft

This permit will supercede and replace Permit R13-2818F issued on June 19, 2014.

Facility Location:	Majorsville, Marshall County, West Virginia
Mailing Address:	1515 Arapahoe St., Tower 1, Suite 1600, Denver, CO 80202-2137
Facility Description:	Natural Gas Extraction/Fractionation Facility
NAICS Codes:	211112
UTM Coordinates:	590.947 km Easting • 4,423.83 km Northing • Zone 17
Permit Type:	Modification
Description of Change:	Modification application to construct one (1) new depropanizer tower (cryogenic plant) to remove liquids from the gas stream. An additional deethanizer will be constructed to remove ethane from the residual natural gas.

Any person whose interest may be affected, including, but not necessarily limited to, the applicant and any person who participated in the public comment process, by a permit issued, modified or denied by the Secretary may appeal such action of the Secretary to the Air Quality Board pursuant to article one [§§22B-1-1 et seq.], Chapter 22B of the Code of West Virginia. West Virginia Code §§22-5-14.

As a result of the granting of this permit, the source is subject to 45CSR30. The Title V (45CSR30) application will be due within twelve (12) months after the date of the commencement of the operation or activity (activities) authorized by this permit, unless granted a deferral or exemption by the Director from such filing deadline pursuant to a request from the permittee.

Table of Contents

1.0. Emission Units

Emission Unit ID	Emission Point ID	Emission Unit Description	Year Installed	Design Capacity	Control Device
C-102	2E	Caterpillar G3608 Compressor Engine	2010	2,370 HP	Oxidation Catalyst
C-103	3E	Caterpillar G3608 Compressor Engine	2010	2,370 HP	Oxidation Catalyst
C-104	4E	Caterpillar G3608 Compressor Engine	2010	2,370 HP	Oxidation Catalyst
H-741	5E	Heatec Process Heater	2010	5.60 MMBtu/hr	None
H-781	6E	Heatec Process Heater	2010	15.40 MMBtu/hr	None
FL-991	1C	Flare	2010	4.4 mmscf/yr	NA
H-2741	9E	Heatec Process Heater	2011	5.60 MMBtu/hr	None
H-3741	10E	Heater M III Regen Heater	2013	7.69 MMBtu/hr	None
H-4741	11E	Heater M IV Regen Heater	2013	7.69 MMBtu/hr	None
H-3781	12E	Heater M III HMO Heater	2013	16.07 MMBtu/hr	None
H-1782	13E	DeEthanizer I HMO Heater	2013	119.2 MMBtu/hr	None
H-1741	14E	DeEthenizer I Regen Heater	2013	14.25 MMBtu/hr	None
FL-1991	3C	Flare DeEth MIV, MVI, MVII	2013	3.65 mmscf/yr	NA
H-5741	15E	Heater M V Regen Heater	2014	7.69 MMBtu/hr	None
H-6741	16E	Heater M VI Regen Heater	2014	7.69 MMBtu/hr	None
H-7741	17E	Heater M VII Regen Heater	2014	7.69 MMBtu/hr	None
H-4781	18E	Heater M IV HMO Heater	2014	16.07 MMBtu/hr	None
H-7781	19E	Heater M VII HMO Heater	2014	16.07 MMBtu/hr	None
H-4782	20E	Stabilization Heater	2014	10.65 MMBtu/hr	None
M1-G-1	21E	Majorsville 1 & 2 Emergency Generator	2013	254 hp	None
M3-G-2	22E	Majorsville 3 Emergency Generator	2014	145 hp	None

Emission Unit ID	Emission Point ID	Emission Unit Description	Year Installed	Design Capacity	Control Device
H-D2782	23E	DeEthanizer II HMO Heater	2017	119.2 MMBTU/hr	None
H-D2741	24E	DeEthanizer II Regen Heater	2017	14.25 MMBTU/hr	None
M3-G-3	25E	Majorsville 3 MCC Emergency Generator	2014	145 hp	None
M4-G-6	26E	Majorsville 4 MCC Emergency Generator	2014	145 hp	None
M4-G-7	27E	Majorsville 4 Emergency Generator	2014	145 hp	None
M7-G-8	28E	Majorsville 7 Emergency Generator	2017	145 hp	None
M7-G-9	29E	Majorsville 7 MCC Emergency Generator	2017	145 hp	None
MD1-G-4	30E	DeEthanizer 1 Control Room Emerg. Gen.	2013	53 hp	None
MD1-G-5	31E	DeEthanizer 1 Emergency Generator	2013	32 hp	None
MD2-G-10	32E	DeEthanizer 2 Control Room Emerg. Gen.	2013	53 hp	None
MD2-G-11	33E	DeEthanizer 2 Emergency Generator	2013	32 hp	None
MT-1	34E	Plant 1 Methanol Tank	2013	520 gal	None
MT-2	35E	Plant 2 Methanol Tank	2013	520 gal	None
MT-3	36E	Plant 3 Methanol Tank	2014	520 gal	None
MT-4	37E	Plant 4 Methanol Tank	2014	520 gal	None
MT-5	38E	Plant 5 Methanol Tank	2014	520 gal	None
MT-6	39E	Plant 6 Methanol Tank	2014	520 gal	None
MT-7	40E	Plant 7 Methanol Tank	2017	520 gal	None
GT-1	41E	Gasoline Dispensing Tank	2014	520 gal	None
DT-1	42E	Diesel Dispensing Tank	2014	520 gal	None
TK-1740	43E	Lube Oil Day Tank	2013	520 gal	None
UOT-1	44E	Used Oil Tank	2013	1,000 gal	None
TK-7411	45E	Lube Oil Tank	2013	2,133 gal	None
TK-7419	46E	Amine Tank	2013	4,200 gal	None
TK-7421	47E	Amine Tank	2013	1,547 gal	None
TK-4825	48E	Compressor Drain Tank	2014	2,326 gal	None
TK-4826	49E	Lube Oil Tank	2014	2,133 gal	None
TK-4824	50E	Closed Drain Tank	2014	4,200 gal	None
TK-4725	51E	Closed Drain Tank	2014	4,200 gal	None

2.0. General Conditions

2.1. Definitions

2.1.1. All references to the "West Virginia Air Pollution Control Act" or the "Air Pollution Control Act" mean those provisions contained in W.Va. Code §§ 22-5-1 to 22-5-18.

2.1.2. The "Clean Air Act" means those provisions contained in 42 U.S.C. §§ 7401 to 7671q, and regulations promulgated thereunder.

2.1.3. "Secretary" means the Secretary of the Department of Environmental Protection or such other person to whom the Secretary has delegated authority or duties pursuant to W.Va. Code §§ 22-1-6 or 22-1-8 (45CSR§30-2.12.). The Director of the Division of Air Quality is the Secretary's designated representative for the purposes of this permit.

2.2. Acronyms

CAAA	Clean Air Act Amendments	**NOx**	Nitrogen Oxides
CBI	Confidential Business Information	**NSPS**	New Source Performance Standards
CEM	Continuous Emission Monitor	**PM**	Particulate Matter
CES	Certified Emission Statement	**$PM_{2.5}$**	Particulate Matter less than 2.5 μm in diameter
C.F.R. *or* CFR	Code of Federal Regulations		
CO	Carbon Monoxide	**PM_{10}**	Particulate Matter less than 10μm in diameter
C.S.R. *or* CSR	Codes of State Rules		
DAQ	Division of Air Quality	**Ppb**	Pounds per Batch
DEP	Department of Environmental Protection	**Pph**	Pounds per Hour
		Ppm	Parts per Million
dscm	Dry Standard Cubic Meter	**Ppmv or ppmv**	Parts per Million by Volume
FOIA	Freedom of Information Act		
HAP	Hazardous Air Pollutant	**PSD**	Prevention of Significant Deterioration
HON	Hazardous Organic NESHAP		
HP	Horsepower	**Psi**	Pounds per Square Inch
lbs/hr	Pounds per Hour	**SIC**	Standard Industrial Classification
LDAR	Leak Detection and Repair		
M	Thousand	**SIP**	State Implementation Plan
MACT	Maximum Achievable Control Technology	**SO_2**	Sulfur Dioxide
		TAP	Toxic Air Pollutant
MDHI	Maximum Design Heat Input	**TPY**	Tons per Year
MM	Million	**TRS**	Total Reduced Sulfur
MMBtu/hr *or* mmbtu/hr	Million British Thermal Units per Hour	**TSP**	Total Suspended Particulate
		USEPA	United States Environmental Protection Agency
MMCF/hr *or* mmcf/hr	Million Cubic Feet per Hour		
		UTM	Universal Transverse Mercator
NA	Not Applicable	**VEE**	Visual Emissions Evaluation
NAAQS	National Ambient Air Quality Standards	**VOC**	Volatile Organic Compounds
		VOL	Volatile Organic Liquids
NESHAPS	National Emissions Standards for Hazardous Air Pollutants		

2.3. Authority

This permit is issued in accordance with West Virginia Air Pollution Control Act W.Va. Code §§ 22-5-1. et seq. and the following Legislative Rules promulgated thereunder:

2.3.1. 45CSR13 – *Permits for Construction, Modification, Relocation and Operation of Stationary Sources of Air Pollutants, Notification Requirements, Temporary Permits, General Permits and Procedures for Evaluation*;

2.4. Term and Renewal

2.4.1. This permit supersedes and replaces previously issued Permit R13-2818F. This Permit shall remain valid, continuous and in effect unless it is revised, suspended, revoked or otherwise changed under an applicable provision of 45CSR13 or any other applicable legislative rule;

2.5. Duty to Comply

2.5.1. The permitted facility shall be constructed and operated in accordance with the plans and specifications filed in Permit Application R13-2818 - R13-2818G and any modifications, administrative updates, or amendments thereto. The Secretary may suspend or revoke a permit if the plans and specifications upon which the approval was based are not adhered to; **[45CSR§§13-5.11 and 10.3.]**

2.5.2. The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the West Virginia Code and the Clean Air Act and is grounds for enforcement action by the Secretary or USEPA;

2.5.3. Violations of any of the conditions contained in this permit, or incorporated herein by reference, may subject the permittee to civil and/or criminal penalties for each violation and further action or remedies as provided by West Virginia Code 22-5-6 and 22-5-7;

2.5.4. Approval of this permit does not relieve the permittee herein of the responsibility to apply for and obtain all other permits, licenses, and/or approvals from other agencies; i.e., local, state, and federal, which may have jurisdiction over the construction and/or operation of the source(s) and/or facility herein permitted.

2.6. Duty to Provide Information

The permittee shall furnish to the Secretary within a reasonable time any information the Secretary may request in writing to determine whether cause exists for administratively updating, modifying, revoking, or terminating the permit or to determine compliance with the permit. Upon request, the permittee shall also furnish to the Secretary copies of records to be kept by the permittee. For information claimed to be confidential, the permittee shall furnish such records to the Secretary along with a claim of confidentiality in accordance with 45CSR31. If confidential information is to be sent to USEPA, the permittee shall directly provide such information to USEPA along with a claim of confidentiality in accordance with 40 C.F.R. Part 2.

2.7. Duty to Supplement and Correct Information

Upon becoming aware of a failure to submit any relevant facts or a submittal of incorrect information in any permit application, the permittee shall promptly submit to the Secretary such supplemental facts or corrected information.

2.8. Administrative Update

The permittee may request an administrative update to this permit as defined in and according to the procedures specified in 45CSR13.
[45CSR§13-4.]

2.9. Permit Modification

The permittee may request a minor modification to this permit as defined in and according to the procedures specified in 45CSR13.
[45CSR§13-5.4.]

2.10 Major Permit Modification

The permittee may request a major modification as defined in and according to the procedures specified in 45CSR14 or 45CSR19, as appropriate.
[45CSR§13-5.1]

2.11. Inspection and Entry

The permittee shall allow any authorized representative of the Secretary, upon the presentation of credentials and other documents as may be required by law, to perform the following:

a. At all reasonable times (including all times in which the facility is in operation) enter upon the permittee's premises where a source is located or emissions related activity is conducted, or where records must be kept under the conditions of this permit;

b. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

c. Inspect at reasonable times (including all times in which the facility is in operation) any facilities, equipment (including monitoring and air pollution control equipment), practices, or operations regulated or required under the permit; and

d. Sample or monitor at reasonable times substances or parameters to determine compliance with the permit or applicable requirements or ascertain the amounts and types of air pollutants discharged.

2.12. Emergency

2.12.1. An "emergency" means any situation arising from sudden and reasonable unforeseeable events beyond the control of the source, including acts of God, which situation requires immediate corrective action to restore normal operation, and that causes the source to exceed a technology-based emission limitation under the permit, due to unavoidable increases in emissions attributable to the emergency. An emergency shall not include noncompliance to the extent caused by

improperly designed equipment, lack of preventative maintenance, careless or improper operation, or operator error.

2.12.2. Effect of any emergency. An emergency constitutes an affirmative defense to an action brought for noncompliance with such technology-based emission limitations if the conditions of Section 2.12.3 are met.

2.12.3. The affirmative defense of emergency shall be demonstrated through properly signed, contemporaneous operating logs, or other relevant evidence that:

a. An emergency occurred and that the permittee can identify the cause(s) of the emergency;

b. The permitted facility was at the time being properly operated;

c. During the period of the emergency the permittee took all reasonable steps to minimize levels of emissions that exceeded the emission standards, or other requirements in the permit; and

d. The permittee submitted notice of the emergency to the Secretary within one (1) working day of the time when emission limitations were exceeded due to the emergency and made a request for variance, and as applicable rules provide. This notice must contain a detailed description of the emergency, any steps taken to mitigate emissions, and corrective actions taken.

2.12.4. In any enforcement proceeding, the permittee seeking to establish the occurrence of an emergency has the burden of proof.

2.12.5 The provisions of this section are in addition to any emergency or upset provision contained in any applicable requirement.

2.13. Need to Halt or Reduce Activity Not a Defense

It shall not be a defense for a permittee in an enforcement action that it should have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit. However, nothing in this paragraph shall be construed as precluding consideration of a need to halt or reduce activity as a mitigating factor in determining penalties for noncompliance if the health, safety, or environmental impacts of halting or reducing operations would be more serious than the impacts of continued operations.

2.14. Suspension of Activities

In the event the permittee should deem it necessary to suspend, for a period in excess of sixty (60) consecutive calendar days, the operations authorized by this permit, the permittee shall notify the Secretary, in writing, within two (2) calendar weeks of the passing of the sixtieth (60) day of the suspension period.

2.15. Property Rights

This permit does not convey any property rights of any sort or any exclusive privilege.

2.16. Severability

The provisions of this permit are severable and should any provision(s) be declared by a court of competent jurisdiction to be invalid or unenforceable, all other provisions shall remain in full force and effect.

2.17. Transferability

This permit is transferable in accordance with the requirements outlined in Section 10.1 of 45CSR13. **[45CSR§13-10.1.]**

2.18. Notification Requirements

The permittee shall notify the Secretary, in writing, no later than thirty (30) calendar days after the actual startup of the operations authorized under this permit.

2.19. Credible Evidence

Nothing in this permit shall alter or affect the ability of any person to establish compliance with, or a violation of, any applicable requirement through the use of credible evidence to the extent authorized by law. Nothing in this permit shall be construed to waive any defense otherwise available to the permittee including, but not limited to, any challenge to the credible evidence rule in the context of any future proceeding.

3.0. Facility-Wide Requirements

3.1. Limitations and Standards

3.1.1. **Open burning.** The open burning of refuse by any person, firm, corporation, association or public agency is prohibited except as noted in 45CSR§6-3.1.
[45CSR§6-3.1.]

3.1.2. **Open burning exemptions.** The exemptions listed in 45CSR§6-3.1 are subject to the following stipulation: Upon notification by the Secretary, no person shall cause, suffer, allow or permit any form of open burning during existing or predicted periods of atmospheric stagnation. Notification shall be made by such means as the Secretary may deem necessary and feasible.
[45CSR§6-3.2.]

3.1.3. **Asbestos.** The permittee is responsible for thoroughly inspecting the facility, or part of the facility, prior to commencement of demolition or renovation for the presence of asbestos and complying with 40 C.F.R. § 61.145, 40 C.F.R. § 61.148, and 40 C.F.R. § 61.150. The permittee, owner, or operator must notify the Secretary at least ten (10) working days prior to the commencement of any asbestos removal on the forms prescribed by the Secretary if the permittee is subject to the notification requirements of 40 C.F.R. § 61.145(b)(3)(i). The USEPA, the Division of Waste Management, and the Bureau for Public Health - Environmental Health require a copy of this notice to be sent to them.
[40CFR§61.145(b) and 45CSR§34]

3.1.4. **Odor.** No person shall cause, suffer, allow or permit the discharge of air pollutants which cause or contribute to an objectionable odor at any location occupied by the public.
[45CSR§4-3.1] ***[State Enforceable Only]***

3.1.5. **Permanent shutdown.** A source which has not operated at least 500 hours in one 12-month period within the previous five (5) year time period may be considered permanently shutdown, unless such source can provide to the Secretary, with reasonable specificity, information to the contrary. All permits may be modified or revoked and/or reapplication or application for new permits may be required for any source determined to be permanently shutdown.
[45CSR§13-10.5.]

3.1.6. **Standby plan for reducing emissions.** When requested by the Secretary, the permittee shall prepare standby plans for reducing the emissions of air pollutants in accordance with the objectives set forth in Tables I, II, and III of 45CSR11.
[45CSR§11-5.2.]

3.2. Monitoring Requirements

[Reserved]

3.3. Testing Requirements

3.3.1. **Stack testing.** As per provisions set forth in this permit or as otherwise required by the Secretary, in accordance with the West Virginia Code, underlying regulations, permits and orders, the permittee shall conduct test(s) to determine compliance with the emission limitations set forth in this permit and/or established or set forth in underlying documents. The Secretary, or his duly authorized representative, may at his option witness or conduct such test(s). Should the Secretary exercise his option to conduct such test(s), the operator shall provide all necessary sampling

connections and sampling ports to be located in such manner as the Secretary may require, power for test equipment and the required safety equipment, such as scaffolding, railings and ladders, to comply with generally accepted good safety practices. Such tests shall be conducted in accordance with the methods and procedures set forth in this permit or as otherwise approved or specified by the Secretary in accordance with the following:

a. The Secretary may on a source-specific basis approve or specify additional testing or alternative testing to the test methods specified in the permit for demonstrating compliance with 40 C.F.R. Parts 60, 61, and 63 in accordance with the Secretary's delegated authority and any established equivalency determination methods which are applicable. If a testing method is specified or approved which effectively replaces a test method specified in the permit, the permit may be revised in accordance with 45CSR§13-4. or 45CSR§13-5.4 as applicable.

b. The Secretary may on a source-specific basis approve or specify additional testing or alternative testing to the test methods specified in the permit for demonstrating compliance with applicable requirements which do not involve federal delegation. In specifying or approving such alternative testing to the test methods, the Secretary, to the extent possible, shall utilize the same equivalency criteria as would be used in approving such changes under Section 3.3.1.a. of this permit. If a testing method is specified or approved which effectively replaces a test method specified in the permit, the permit may be revised in accordance with 45CSR§13-4. or 45CSR§13-5.4 as applicable.

c. All periodic tests to determine mass emission limits from or air pollutant concentrations in discharge stacks and such other tests as specified in this permit shall be conducted in accordance with an approved test protocol. Unless previously approved, such protocols shall be submitted to the Secretary in writing at least thirty (30) days prior to any testing and shall contain the information set forth by the Secretary. In addition, the permittee shall notify the Secretary at least fifteen (15) days prior to any testing so the Secretary may have the opportunity to observe such tests. This notification shall include the actual date and time during which the test will be conducted and, if appropriate, verification that the tests will fully conform to a referenced protocol previously approved by the Secretary.

d. The permittee shall submit a report of the results of the stack test within sixty (60) days of completion of the test. The test report shall provide the information necessary to document the objectives of the test and to determine whether proper procedures were used to accomplish these objectives. The report shall include the following: the certification described in paragraph 3.5.1.; a statement of compliance status, also signed by a responsible official; and, a summary of conditions which form the basis for the compliance status evaluation. The summary of conditions shall include the following:

    1. The permit or rule evaluated, with the citation number and language;
    2. The result of the test for each permit or rule condition; and,
    3. A statement of compliance or noncompliance with each permit or rule condition.

[WV Code § 22-5-4(a)(14-15) and 45CSR13]

3.4. Recordkeeping Requirements

3.4.1. **Retention of records.** The permittee shall maintain records of all information (including monitoring data, support information, reports, and notifications) required by this permit recorded in a form suitable and readily available for expeditious inspection and review. Support information includes all calibration and maintenance records and all original strip-chart recordings for continuous monitoring instrumentation. The files shall be maintained for at least five (5) years following the date of each occurrence, measurement, maintenance, corrective action, report, or record. At a minimum, the most recent two (2) years of data shall be maintained on site. The remaining three (3) years of data may be maintained off site, but must remain accessible within a reasonable time. Where appropriate, the permittee may maintain records electronically (on a computer, on computer floppy disks, CDs, DVDs, or magnetic tape disks), on microfilm, or on microfiche.

3.4.2. **Odors.** For the purposes of 45CSR4, the permittee shall maintain a record of all odor complaints received, any investigation performed in response to such a complaint, and any responsive action(s) taken.
[45CSR§4. *State Enforceable Only.*]

3.5. Reporting Requirements

3.5.1. **Responsible official.** Any application form, report, or compliance certification required by this permit to be submitted to the DAQ and/or USEPA shall contain a certification by the responsible official that states that, based on information and belief formed after reasonable inquiry, the statements and information in the document are true, accurate, and complete.

3.5.2. **Confidential information.** A permittee may request confidential treatment for the submission of reporting required by this permit pursuant to the limitations and procedures of W.Va. Code § 22-5-10 and 45CSR31.

3.5.3. **Correspondence.** All notices, requests, demands, submissions and other communications required or permitted to be made to the Secretary of DEP and/or USEPA shall be made in writing and shall be deemed to have been duly given when delivered by hand, or mailed first class or by private carrier with postage prepaid to the address(es), or submitted in electronic format by email as set forth below or to such other person or address as the Secretary of the Department of Environmental Protection may designate:

DAQ:
Director
WVDEP
Division of Air Quality
601 57th Street
Charleston, WV 25304-2345

DAQ Compliance and Enforcement[1]:
DAQAirQualityReports@wv.gov

US EPA:
Associate Director
Office of Air Enforcement and Compliance Assistance
(3AP20)
U.S. Environmental Protection Agency
Region III
1650 Arch Street
Philadelphia, PA 19103-2029

[1]For all self-monitoring reports (MACT, GACT, NSPS, etc.), stack tests and protocols, Notice of Compliance Status Reports, Initial Notifications, etc.

3.5.4. **Operating Fee**

3.5.4.1. In accordance with 45CSR30 – Operating Permit Program, the permittee shall submit a certified emissions statement and pay fees on an annual basis in accordance with the submittal requirements of the Division of Air Quality. A receipt for the appropriate fee shall be maintained on the premises for which the receipt has been issued, and shall be made immediately available for inspection by the Secretary or his/her duly authorized representative.

3.5.5. **Emission inventory.** At such time(s) as the Secretary may designate, the permittee herein shall prepare and submit an emission inventory for the previous year, addressing the emissions from the facility and/or process(es) authorized herein, in accordance with the emission inventory submittal requirements of the Division of Air Quality. After the initial submittal, the Secretary may, based upon the type and quantity of the pollutants emitted, establish a frequency other than on an annual basis.

4.0. Source-Specific Requirements

4.1. Limitations and Standards

4.1.1. **Record of Monitoring.** The permittee shall keep records of monitoring information that include the following:

a. The date, place as defined in this permit, and time of sampling or measurements;
b. The date(s) analyses were performed;
c. The company or entity that performed the analyses;
d. The analytical techniques or methods used;
e. The results of the analyses; and
f. The operating conditions existing at the time of sampling or measurement.

4.1.2. **Minor Source of Hazardous Air Pollutants (HAP).** HAP emissions from the facility shall be less than 10 tons/year of any single HAP and 25 tons/year of any combination of HAPs. Compliance with this Section shall ensure that the facility is a minor HAP source.

4.1.3. **Operation and Maintenance of Air Pollution Control Equipment.** The permittee shall, to the extent practicable, install, maintain, and operate all pollution control equipment listed in Section 1.0 and associated monitoring equipment in a manner consistent with safety and good air pollution control practices for minimizing emissions, or comply with any more stringent limits set forth in this permit or as set forth by any State rule, Federal regulation, or alternative control plan approved by the Secretary.
[45CSR§13-5.11.]

4.1.4. **Record of Malfunctions of Air Pollution Control Equipment.** For all air pollution control equipment listed in Section 1.0, the permittee shall maintain records of the occurrence and duration of any malfunction or operational shutdown of the air pollution control equipment during which excess emissions occur. For each such case, the following information shall be recorded:

a. The equipment involved.
b. Steps taken to minimize emissions during the event.
c. The duration of the event.
d. The estimated increase in emissions during the event.

For each such case associated with an equipment malfunction, the additional information shall also be recorded:

e. The cause of the malfunction.
f. Steps taken to correct the malfunction.
g. Any changes or modifications to equipment or procedures that would help prevent future recurrences of the malfunction.

4.1.5. **Maximum Throughput Limitation.** The total maximum combined wet natural gas throughput through the gas processing plants shall not exceed 1,500 mmscf/day. To demonstrate compliance, the permittee shall maintain records of the amount of natural gas processed in the gas processing plant.

5.0. Source-Specific Requirements (Engines (C-102, C-103, C-104), Emergency Generators (M3-G-2, M3-G-3, M4-G-6, M4-G-7, M7-G-8, M7-G-9, M1-G-1, MD1-G-4, MD2-G-10, MD1-G-5, MD2-G-11))

5.1. Limitations and Standards

5.1.1. The quantity of natural gas that shall be consumed in each of the 2,370 hp natural gas fired reciprocating engines, Caterpillar G3608 (C-102, C-103, C-104) shall not exceed 13,978 cubic feet per hour or 122.45 x 10^6 cubic feet per year.

5.1.2. Maximum emissions from each of the 2,370 hp natural gas fired reciprocating engines, Caterpillar G3608 (C-102, C-103, C-104) shall not exceed the following limits:

Emission Unit ID	Pollutant	Maximum Hourly Emissions (lb/hr)	Maximum Annual Emissions (ton/year)
C-102 C-103 C-104	Nitrogen Oxides	2.61	11.44
	Carbon Monoxide	0.99	4.35
	Volatile Organic Compounds (includes Formaldehyde)	2.09	9.15
	Formaldehyde	0.42	1.83

5.1.3. Requirements for Use of Oxidation Catalysts

a. Lean-burn natural gas compressor engines (C-102, C-103, C-104) equipped with oxidation catalyst air pollution control devices shall be fitted with a closed-loop automatic air/fuel ratio feedback controller to ensure emissions of regulated pollutants do not exceed the emission limits listed in permit condition 5.1.2 for any engine/oxidation catalyst combination under varying load. The closed-loop, automatic air/fuel ratio controller shall control a fuel metering valve to ensure a lean-rich mixture.

b. For natural gas compressor engines (C-102, C-103, C-104), the permittee shall monitor the temperature to the inlet of the catalyst and in accordance with manufacturer's specifications; a high temperature alarm shall shut off the engine before thermal deactivation of the catalyst occurs. If the engine shuts off due to high temperature, the permittee shall also check for thermal deactivation of the catalyst before normal operations are resumed.

c. The permittee shall follow a written operation and maintenance plan that provides the periodic and annual maintenance requirements.

d. No person shall knowingly:

1. Remove or render inoperative any air pollution or auxiliary air pollution control device installed subject to the requirements of this permit;
2. Install any part or component when the principal effect of the part or component is to bypass, defeat or render inoperative any air pollution control device or auxiliary air pollution control device installed subject to the requirements of this permit; or
3. Cause or allow engine exhaust gases to bypass any catalytic reduction device.

5.1.4. Maximum emissions from each of the 145 hp diesel fired emergency generators, Cummins 60DSFAD (M3-G-2, M3-G-3, M4-G-6, M4-G-7, M7-G-8, M7-G-9) shall not exceed the following limits:

Pollutant	Maximum Hourly Emissions (lb/hr)	Maximum Annual Emissions (ton/year)
Nitrogen Oxides	0.70	0.18
Carbon Monoxide	0.18	0.04

5.1.5. Maximum emissions from the 254 hp natural gas fired emergency generator, Generac V-type (M1-G-1) shall not exceed the following limits:

Pollutant	Maximum Hourly Emissions (lb/hr)	Maximum Annual Emissions (ton/year)
Nitrogen Oxides	1.12	0.28
Carbon Monoxide	1.68	0.42
Volatile Organic Compounds	0.56	0.14

5.1.6. Maximum emissions from each of the 53 hp diesel fired emergency generators, Generac MMG45 (MD1-G-4, MD2-G-10) shall not exceed the following limits:

Pollutant	Maximum Hourly Emissions (lb/hr)	Maximum Annual Emissions (ton/year)
Nitrogen Oxides	0.41	0.10
Carbon Monoxide	0.43	0.11
Volatile Organic Compounds	0.41	0.10

5.1.7. Maximum emissions from each of the 32 hp diesel fired emergency generators, Generac MM25 (MD1-G-5, MD2-G-11) shall not exceed the following limits:

Pollutant	Maximum Hourly Emissions (lb/hr)	Maximum Annual Emissions (ton/year)
Nitrogen Oxides	0.25	0.06
Carbon Monoxide	0.29	0.07
Volatile Organic Compounds	0.25	0.06

5.1.8. **Maximum Yearly Operation Limitation**. The maximum yearly hours of operation for each of the emergency generators (M3-G-2, M3-G-3, M4-G-6, M4-G-7, M7-G-8, M7-G-9, M1-G-1, MD1-G-4, MD2-G-10, MD1-G-5, MD2-G-11) shall not exceed 500 hours per year. Compliance with the Maximum Yearly Operation Limitation shall be determined using a twelve month rolling total. A twelve month rolling total shall mean the sum of the hours of operation at any given time during the previous twelve consecutive calendar months.

5.2. Monitoring Requirements

5.2.1. Catalytic Oxidizer Control Devices

a. The permittee shall regularly inspect, properly maintain and/or replace catalytic reduction devices and auxiliary air pollution control devices to ensure functional and effective operation of the engine's physical and operational design. The permittee shall ensure proper operation, maintenance and performance of catalytic reduction devices and auxiliary air pollution control devices by:

1. Maintaining proper operation of the automatic air/fuel ratio controller or automatic feedback controller.
2. Following operating and maintenance recommendations of the catalyst element manufacturer.

5.3. Testing Requirements

5.3.1. See Facility-Wide Testing Requirements Section 3.3 and Testing Requirements Sections 8.4 and 9.2.

5.4. Recordkeeping Requirements

5.4.1. To demonstrate compliance with section 5.1, the permittee shall maintain records of the amount and type of fuel consumed in each engine and emergency generator and the hours of operation of each engine and emergency generator. Said records shall be maintained on site or in a readily accessible off-site location maintained by the permittee for a period of five (5) years. Said records shall be readily available to the Director of the Division of Air Quality or his/her duly authorized representative for expeditious inspection and review. Any records submitted to the agency pursuant to a requirement of this permit or upon request by the Director shall be certified by a responsible official.

5.5. Reporting Requirements

5.5.1. See Facility-Wide Reporting Requirements Section 3.5 and Reporting Requirements Sections 8.5 and 9.3.

6.0. Source-Specific Requirements (Heaters)

6.1. Limitations and Standards

6.1.1. Maximum Design Heat Input (MDHI). The MDHI for each of the process heaters shall not exceed the following:

Emission Unit ID#	Emission Point ID#	Process Heater Description	MDHI (MMBtu/hr)
H-741	5E	Process Heater[1]	5.60
H-781	6E	Process Heater[1]	15.40
H-2741	9E	Process Heater[1]	5.60
H-3741	10E	M III Regen Heater[1]	7.69
H-4741	11E	M IV Regen Heater[1]	7.69
H-3781	12E	M III HMO Heater[2]	16.07
H-1782	13E	DeEthanizer I HMO Heater[3]	119.2
H-D2782	23E	DeEthanizer II HMO Heater[3]	119.2
H-1741	14E	DeEthanizer I Regen Heater[2]	14.25
H-D2741	24E	Deethanizer II Regen Heater[2]	14.25
H-5741	15E	M V Regen Heater[1]	7.69
H-6741	16E	M VI Regen Heater[1]	7.69
H-7741	17E	M VII Regen Heater[1]	7.69
H-4781	18E	M IV HMO Heater[2]	16.07
H-7781	19E	M VII HMO Heater[2]	16.07
H-4782	20E	Stabilization Heater	10.65

1 – Unit is a process heater per 45CSR§2-26.
2 – Unit is a process heater per 45CSR§2-26 and 40CFR §60.41c.
3 – Unit is a process heater per 45CSR§2-26, 40CFR §60.41b and 40CFR §60.41c.

6.1.2. Maximum emissions from each of the process heaters shall not exceed the following limits:

Emission Unit ID#	NO_x		CO		VOC	
	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr
H-741	0.30	1.32	0.46	2.02	0.03	0.13
H-781	1.34	5.85	1.27	5.56	0.08	0.36
H-2741	0.30	1.32	0.46	2.02	0.03	0.13
H-3741	0.41	1.80	0.32	1.38	0.04	0.18
H-4741	0.41	1.80	0.32	1.38	0.04	0.18
H-3781	1.61	7.04	1.32	5.80	0.09	0.38
H-1782	3.58	15.66	4.77	20.88	0.64	2.82
H-D2782	3.58	15.66	4.77	20.88	0.64	2.82
H-1741	0.57	2.50	0.58	2.56	0.27	1.19

H-D2741	0.57	2.50	0.58	2.56	0.27	1.19
H-5741	0.41	1.80	0.32	1.38	0.04	0.18
H-6741	0.41	1.80	0.32	1.38	0.04	0.18
H-7741	0.41	1.80	0.32	1.38	0.04	0.18
H-4781	1.61	7.04	1.32	5.80	0.09	0.38
H-7781	1.61	7.04	1.32	5.80	0.09	0.38
H-4782	0.63	2.74	0.88	3.84	0.06	0.25

6.1.3. No person shall cause, suffer, allow or permit emission of smoke and/or particulate matter into the open air from any fuel burning unit which is greater than ten (10) percent opacity based on a six minute block average.
[45CSR§2-3.1.]

6.2. Monitoring Requirements

6.2.1. At such reasonable times as the Secretary may designate, the permittee shall conduct Method 9 emission observations for the purpose of demonstrating compliance with Section 6.1.3. Method 9 shall be conducted in accordance with 40 CFR 60 Appendix A.

6.2.2. For each month, the permittee shall record the hours of operation and amount of fuel gas consumed by heaters listed in permit condition 6.1.1. Such records shall be maintained in accordance with Condition 3.4.1. of this permit.
[40 CFR §60.48c(g)(2) and 45CSR§2A-7.1.a.1.]

6.3. Testing Requirements

6.3.1. Compliance with the visible emission requirements of section 6.1.3 shall be determined in accordance with 40 CFR Part 60, Appendix A, Method 9 or by using measurements from continuous opacity monitoring systems approved by the Director. The Director may require the installation, calibration, maintenance and operation of continuous opacity monitoring systems and may establish policies for the evaluation of continuous opacity monitoring results and the determination of compliance with the visible emission requirements of section 6.1.3. Continuous opacity monitors shall not be required on fuel burning units which employ wet scrubbing systems for emission control.
[45CSR§2-3.2.]

6.4. Recordkeeping Requirements

6.4.1. The permittee shall maintain records of all monitoring data required by Section 6.2.1 documenting the date and time of each visible emission check, the emission point or equipment/source identification number, the name or means of identification of the observer, the results of the check(s), whether the visible emissions are normal for the process, and, if applicable, all corrective measures taken or planned. The permittee shall also record the general weather conditions (i.e. sunny, approximately 80°F, 6 - 10 mph NE wind) during the visual emission check(s). Should a visible emission observation be required to be performed per the requirements specified in Method 9, the data records of each observation shall be maintained per the requirements of Method 9.

6.5. Reporting Requirements

6.5.1. Any deviation(s) from the allowable visible emission requirement for any emission source discovered during observations using 40CFR Part 60, Appendix A, Method 9 or 22 shall be reported in writing to the Director of the Division of Air Quality as soon as practicable, but in any case within ten (10) calendar days of the occurrence and shall include at least the following

information: the results of the visible determination of opacity of emissions, the cause or suspected cause of the violation(s), and any corrective measures taken or planned.

7.0. Source-Specific Requirements (Flares)

7.1. Limitations and Standards

7.1.1. For purposes of determining potential HAP emissions at production-related facilities, the methods specified in 40 CFR 63, Subpart HH (i.e. excluding compressor engines from HAP PTE) shall be used.

7.1.2. Flares subject to this section shall be designed and operated in accordance with the following:

a Flares FL-991 & FL-1991 shall be air-assisted.

b. Flares FL-991 & FL-1991 shall be designed for and operated with no visible emissions, except for periods not to exceed a total of 5 minutes during any 2 consecutive hours.

c. Flares FL-991 & FL-1991 shall be operated, with a flame present at all times whenever emissions may be vented to them, except during SSM (Startup, Shutdown, Malfunctions) events.

d. A flare shall be used only where the net heating value of the gas being combusted is 11.2 MJ/scm (300 Btu/scf) or greater if the flare is steam-assisted or air-assisted; or where the net heating value of the gas being combusted is 7.45 MJ/scm (200 Btu/scf) or greater if the flares are non-assisted. The net heating value of the gas being combusted in a flare shall be calculated using the following equation:

$$H_T = K\sum_{i=1}^{n} C_i H_i$$

Where:

H_T=Net heating value of the sample, MJ/scm; where the net enthalpy per mole of off gas is based on combustion at 25 °C and 760 mm Hg, but the standard temperature for determining the volume corresponding to one mole is 20 °C.

K=Constant=

$$1.740\times10^{-7}\left(\frac{1}{ppmv}\right)\left(\frac{\text{g-mole}}{\text{scm}}\right)\left(\frac{\text{MJ}}{\text{kcal}}\right)$$

where the standard temperature for (g-mole/scm) is 20 °C.

C_i=Concentration of sample component i in ppmv on a wet basis, which may be measured for organics by Test Method 18, but is not required to be measured using Method 18 (unless designated by the Director).

H_i=Net heat of combustion of sample component i, kcal/g-mole at 25 °C and 760 mm Hg. The heats of combustion may be determined using ASTM D2382–76 or 88 or D4809–95 if published values are not available or cannot be calculated.

n=Number of sample components.

e. Air-assisted flares shall be designed and operated with an exit velocity less than the velocity V_{max}. The maximum permitted velocity, V_{max}, for air-assisted flares shall be determined by the following equation:

$$V_{max}=8.71 + 0.708(H_T)$$

Where:

V_{max}=Maximum permitted velocity, m/sec.
8.71=Constant.
0.708=Constant.
H_T=The net heating value as determined in 7.1.2.d of this section.

7.1.3. The permittee is not required to conduct a flare compliance assessment for concentration of sample (i.e. Method 18) and tip velocity (i.e. Method 2) until such time as the Director requests a flare compliance assessment to be conducted in accordance with section 7.3.2, but the permittee is required to conduct a flare design evaluation in accordance with section 7.4.2. Alternatively, the permittee may elect to demonstrate compliance with the flare design criteria requirements of section 7.1.4 by complying with the compliance assessment testing requirements of section 7.3.2.

7.1.4. Maximum emissions from the flare pilots (FL-991 & FL-1991) shall not exceed the following limits:

Emission Unit ID#	NO_x		CO	
	lb/hr	tpy	lb/hr	tpy
FL-991	0.05	0.22	0.04	0.18
FL-1991	0.49	0.20	2.47	0.26

7.1.5. Visible particulate matter emissions from the flares (FL-991 & FL-1991) shall not exceed twenty (20%) percent opacity
[45CSR§6-4.3.]

7.1.6. The provisions of permit condition 7.1.5 shall not apply to smoke which is less than forty (40%) percent opacity, for a period or periods aggregating no more than eight (8) minutes per start-up.
[45CSR§6-4.4.]

7.1.7. The flares (FL-991 & FL-1991) including all associated equipment and grounds, shall be designed, operated and maintained so as to prevent the emission of objectionable odors.
[45CSR§6-4.6.]

7.1.8 No person shall cause or allow particulate matter to be discharged from any incinerator into the open air in excess of the quantity determined by use of the following formula:

Emissions (lb/hr) = F x Incinerator Capacity (tons/hr)

Where, the factor, F, is as indicated in Table I below:

Table I: Factor, F, for Determining Maximum Allowable Particulate Emissions.

Incinerator Capacity	Factor F
A. Less than 15,000 lbs/hr	5.43
B. 15,000 lbs/hr or greater	2.72

[45CSR§6-4.1.]

7.1.9 Maximum pilot light fuel consumption for flares FL-991 & FL-1991 shall not exceed 8.34 scfm for FL-991 and 6.95 scfm for FL-1991. Compliance with this requirement demonstrates compliance with the emission limits of 7.1.4 of this permit.

7.1.10. The inlet gas flow rate must be equal to or less than the maximum specified by the manufacturer.

7.1.11. The permittee will comply with the requirements of Section 2.12 of this permit during emergency operation of the flares (FL-991 & FL-1991).

7.2. Monitoring Requirements

7.2.1. In order to demonstrate compliance with the requirements of 7.1.2.c, the permittee shall monitor the presence or absence of a flare pilot flame using a thermocouple or any other equivalent device, except during SSM events.

7.2.2. The permittee shall monitor the throughput of wet natural gas fed to each flare control device (FL-991 & FL-1991) on a monthly basis.

7.3. Testing Requirements

7.3.1. In order to demonstrate compliance with the flare opacity requirements the permittee shall conduct a Method 22 opacity test for at least two hours. This test shall demonstrate no visible emissions are observed for more than a total of 5 minutes during any 2 consecutive hour period using 40CFR60 Appendix A Method 22. The permittee shall conduct this test within one (1) year of permit issuance or initial startup whichever is later. The visible emission checks shall determine the presence or absence of visible emissions. At a minimum, the observer must be trained and knowledgeable regarding the effects of background contrast, ambient lighting, observer position relative to lighting, wind, and the presence of uncombined water (condensing water vapor) on the visibility of emissions. This training may be obtained from written materials found in the References 1 and 2 from 40 CFR part 60, appendix A, Method 22 or from the lecture portion of 40 CFR part 60, appendix A, Method 9 certification course.

7.3.2. The Director may require the permittee to conduct a flare compliance assessment. This compliance assessment testing shall be conducted in accordance with Test Method 18 for organics and Test Method 2, 2A, 2C, or 2D in appendix A to 40 CFR part 60, as appropriate, or other equivalent testing approved in writing by the Director. Also, Test Method 18 may require the permittee to conduct Test Method 4 in conjunction with Test Method 18.

7.4. Recordkeeping Requirements

7.4.1. For the purpose of demonstrating compliance with section 7.1.2.c and 7.2.1, the permittee shall maintain records of the times and duration of all periods which the pilot flame was absent.

7.4.2 For the purpose of demonstrating compliance with section 7.1.2 and 7.3.2, the permittee shall maintain a record of the flare design evaluation. The flare design evaluation shall include, net heat value calculations, exit (tip) velocity calculations, and all supporting concentration calculations and other related information requested by the Director.

7.4.3. The permittee shall document and maintain the corresponding records specified by the on-going monitoring requirements of 7.2 and testing requirements of 7.3.

7.4.4. For the purpose of demonstrating compliance with section 7.1.2.b, the permittee shall maintain records of the visible emission opacity tests conducted per Section 7.3.1.

7.4.5. All records required under Section 7.4 shall be maintained on site or in a readily accessible off-site location maintained by the permittee for a period of five (5) years. Said records shall be readily available to the Director of the Division of Air Quality or his/her duly authorized representative for expeditious inspection and review. Any records submitted to the agency pursuant to a requirement of this permit or upon request by the Director shall be certified by a responsible official.

7.4.6. The permittee shall maintain a monthly record of the wet natural gas throughput each flare control device (FL-991 & FL-1991). Said records shall be maintained for a period of five (5) years on site or in a readily accessible off-site location maintained by the permittee. Said records shall be readily available to the Director of the Division of Air Quality or his/her duly authorized representative for expeditious inspection and review. Any records submitted to the agency pursuant to a requirement of this permit or upon request by the Director shall be certified by a responsible official.

7.5. Reporting Requirements

7.5.1 If permittee is required by the Director to demonstrate compliance with section 7.1.1, then the permittee shall submit a testing protocol at least thirty (30) days prior to testing and shall submit a notification of the testing date at least fifteen (15) days prior to testing. The permittee shall submit the testing results within sixty (60) days of testing and provide all supporting calculations and testing data.

7.5.2. Any deviation(s) from the allowable visible emission requirement for any emission source discovered during observations using 40CFR Part 60, Appendix A, Method 9 or 22 shall be reported in writing to the Director of the Division of Air Quality as soon as practicable, but in any case within ten (10) calendar days of the occurrence and shall include at least the following information: the results of the visible determination of opacity of emissions, the cause or suspected cause of the violation(s), and any corrective measures taken or planned.

7.5.3. Any deviation(s) from the flare design and operation criteria in Section 7.1.2 shall be reported in writing to the Director of the Division of Air Quality as soon as practicable, but in any case within ten (10) calendar days of discovery of such deviation.

7.5.4. The permittee shall report to the Director, the time, cause of event, estimate of emissions and corrective actions taken when the flare was used for an emergency at the facility.

8.0. Source-Specific Requirements (40CFR60 Subpart JJJJ Requirements (C-102, C-103, C-104, M1-G-1))

8.1. Limitations and Standards

8.1.1. The provisions of this subpart are applicable to owners, and operators of stationary spark ignition (SI) internal combustion engines (ICE) as specified below. For the purposes of this subpart, the date that construction commences is the date the engine is ordered by the owner or operator.

a. Owners and operators of stationary SI ICE that commence construction after June 12, 2006, where the stationary SI ICE are manufactured:

1. On or after July 1, 2007, for engines with a maximum engine power greater than or equal to 500 HP (except lean burn engines with a maximum engine power greater than or equal to 500 HP and less than 1,350 HP);

2. on or after January 1, 2008, for lean burn engines with a maximum engine power greater than or equal to 500 HP and less than 1,350 HP;

3. on or after July 1, 2008, for engines with a maximum engine power less than 500 HP; or

4. on or after January 1, 2009, for emergency engines with a maximum engine power greater than 19 KW (25 HP).

b. Owners and operators of stationary SI ICE that commence modification or reconstruction after June 12, 2006.

[40CFR§60.4230(a)]

8.2. Emission Standards for Owners and Operators

8.2.1. Owners and operators of stationary SI ICE with a maximum engine power greater than or equal to 75 KW (100 HP) (except gasoline and rich burn engines that use LPG) must comply with the emission standards in Table 1 to this subpart for their stationary SI ICE. For owners and operators of stationary SI ICE with a maximum engine power greater than or equal to 100 HP (except gasoline and rich burn engines that use LPG) manufactured prior to January 1, 2011 that were certified to the certification emission standards in 40 CFR part 1048 applicable to engines that are not severe duty engines, if such stationary SI ICE was certified to a carbon monoxide (CO) standard above the standard in Table 1 to this subpart, then the owners and operators may meet the CO certification (not field testing) standard for which the engine was certified.
[40CFR§60.4233(e)] (C-102, C-103, C-104, M1-G-1)

8.2.2. Owners and operators of any modified or reconstructed stationary SI ICE subject to this subpart must meet the requirements as specified in paragraphs (f)(1) through (5) of this section.

a. Owners and operators of stationary SI ICE with a maximum engine power less than or equal to 19 KW (25 HP), that are modified or reconstructed after June 12, 2006, must comply with the same emission standards as those specified in paragraph (a) of this section.

b. Owners and operators of stationary SI ICE with a maximum engine power greater than 19 KW (25 HP) that use gasoline engines, that are modified or reconstructed after June 12, 2006, must comply with the same emission standards as those specified in paragraph (b) of this section.

c. Owners and operators of stationary SI ICE with a maximum engine power greater than 19 KW (25 HP) that are rich burn engines that use LPG, that are modified or reconstructed after June 12, 2006, must comply with the same emission standards as those specified in paragraph (c) of this section.

d. Owners and operators of stationary SI natural gas and lean burn LPG engines with a maximum engine power greater than 19 KW (25 HP), that are modified or reconstructed after June 12, 2006, must comply with the same emission standards as those specified in paragraph (d) or (e) of this section, except that such owners and operators of non-emergency engines and emergency engines greater than or equal to 130 HP must meet a nitrogen oxides (NO_X) emission standard of 3.0 grams per HP-hour (g/HP-hr), a CO emission standard of 4.0 g/HP-hr (5.0 g/HP-hr for non-emergency engines less than 100 HP), and a volatile organic compounds (VOC) emission standard of 1.0 g/HP-hr, or a NO_X emission standard of 250 ppmvd at 15 percent oxygen (O_2), a CO emission standard 540 ppmvd at 15 percent O_2(675 ppmvd at 15 percent $O_2$for non-emergency engines less than 100 HP), and a VOC emission standard of 86 ppmvd at 15 percent O_2, where the date of manufacture of the engine is:

1. Prior to July 1, 2007, for non-emergency engines with a maximum engine power greater than or equal to 500 HP.
2. Prior to July 1, 2008, for non-emergency engines with a maximum engine power less than 500 HP.
3. Prior to January 1, 2009, for emergency engines.

e. Owners and operators of stationary SI landfill/digester gas ICE engines with a maximum engine power greater than 19 KW (25 HP), that are modified or reconstructed after June 12, 2006, must comply with the same emission standards as those specified in paragraph (e) of this section for stationary landfill/digester gas engines.
[40CFR§60.4233(f)] (C-102, C-103, C-104)

8.2.3. Owners and operators of stationary SI ICE must operate and maintain stationary SI ICE that achieve the emission standards as required in §60.4233 over the entire life of the engine.
[40CFR§60.4234] (C-102, C-103, C-104, M1-G-1)

8.2.4. Starting on January 1, 2011, if the emergency stationary SI internal combustion engine that is greater than or equal to 130 HP and less than 500 HP that was built on or after January 1, 2011, does not meet the standards applicable to non-emergency engines, the owner or operator must install a nonresettable hour meter.
[40CFR§60.4237(b)] (M1-G-1)

8.3. Compliance Requirements for Owners and Operators

8.3.1. If you are an owner or operator of a stationary SI internal combustion engine and must comply with the emission standards specified in §60.4233(d) or (e), you must demonstrate compliance according to one of the methods specified in paragraphs (b)(1) and (2) of this section.

a. Purchasing an engine certified according to procedures specified in this subpart, for the same model year and demonstrating compliance according to one of the methods specified in paragraph (a) of this section.

b. Purchasing a non-certified engine and demonstrating compliance with the emission standards specified in §60.4233(d) or (e) and according to the requirements specified in §60.4244, as applicable, and according to paragraphs (b)(2)(i) and (ii) of this section.

1. If you are an owner or operator of a stationary SI internal combustion engine greater than 25 HP and less than or equal to 500 HP, you must keep a maintenance plan and records of conducted maintenance and must, to the extent practicable, maintain and operate the engine in a manner consistent with good air pollution control practice for minimizing emissions. In addition, you must conduct an initial performance test to demonstrate compliance.

2. If you are an owner or operator of a stationary SI internal combustion engine greater than 500 HP, you must keep a maintenance plan and records of conducted maintenance and must, to the extent practicable, maintain and operate the engine in a manner consistent with good air pollution control practice for minimizing emissions. In addition, you must conduct an initial performance test and conduct subsequent performance testing every 8,760 hours or 3 years, whichever comes first, thereafter to demonstrate compliance.

[40CFR§60.4243(b)] (C-102, C-103, C-104)

8.3.2. If you are an owner or operator of a stationary SI internal combustion engine that must comply with the emission standards specified in §60.4233(f), you must demonstrate compliance according paragraph (b)(2)(i) or (ii) of this section, except that if you comply according to paragraph (b)(2)(i) of this section, you demonstrate that your non-certified engine complies with the emission standards specified in §60.4233(f). **[40CFR§60.4243(c)] (C-102, C-103, C-104)**

8.3.3. If you are an owner/operator of an stationary SI internal combustion engine with maximum engine power greater than or equal to 500 HP that is manufactured after July 1, 2007 and before July 1, 2008, and must comply with the emission standards specified in sections 60.4233(b) or (c), you must comply by one of the methods specified in paragraphs (h)(1) through (h)(4) of this section.

a. Purchasing an engine certified according to 40 CFR part 1048. The engine must be installed and configured according to the manufacturer's specifications.

b. Keeping records of performance test results for each pollutant for a test conducted on a similar engine. The test must have been conducted using the same methods specified in this subpart and these methods must have been followed correctly.

c. Keeping records of engine manufacturer data indicating compliance with the standards.

d. Keeping records of control device vendor data indicating compliance with the standards. **[40CFR§60.4243(h)] (C-102, C-103, C-104)**

8.3.4. If you own or operate an emergency stationary ICE, you must operate the emergency stationary ICE according to the requirements in paragraphs (d)(1) through (3) of this section. In order for the engine to be considered an emergency stationary ICE under this subpart, any operation other than emergency operation, maintenance and testing, emergency demand response, and operation in non-emergency situations for 50 hours per year, as described in paragraphs (d)(1) through (3) of this section, is prohibited. If you do not operate the engine according to the requirements in paragraphs (d)(1) through (3) of this section, the engine will not be considered an emergency engine under this subpart and must meet all requirements for non-emergency engines. **[40CFR§60.4243(d)] (M1-G-1)**

8.4. Testing Requirements for Owners and Operators

8.4.1. Owners and operators of stationary SI ICE who conduct performance tests must follow the procedures in paragraphs (a) through (f) of this section.

a. Each performance test must be conducted within 10 percent of 100 percent peak (or the highest achievable) load and according to the requirements in §60.8 and under the specific conditions that are specified by Table 2 to this subpart. [40CFR§60.4244(a)]

b. You may not conduct performance tests during periods of startup, shutdown, or malfunction, as specified in §60.8(c). If your stationary SI internal combustion engine is non-operational, you do not need to startup the engine solely to conduct a performance test; however, you must conduct the performance test immediately upon startup of the engine. [40CFR§60.4244(b)]

c. You must conduct three separate test runs for each performance test required in this section, as specified in §60.8(f). Each test run must be conducted within 10 percent of 100 percent peak (or the highest achievable) load and last at least 1 hour. [40CFR§60.4244(c)]

d. To determine compliance with the NO_X mass per unit output emission limitation, convert the concentration of NO_X in the engine exhaust using Equation 1 of this section:

$$ER = \frac{C_d \times 1.912 \times 10^{-3} \times Q \times T}{HP - hr} \qquad (Eq. 1)$$

Where:
ER = Emission rate of NO_X in g/HP-hr.

C_d= Measured NO_X concentration in parts per million by volume (ppmv).

1.912×10^{-3} = Conversion constant for ppm NO_X to grams per standard cubic meter at 20 degrees Celsius.

Q = Stack gas volumetric flow rate, in standard cubic meter per hour, dry basis.

T = Time of test run, in hours.

HP-hr = Brake work of the engine, horsepower-hour (HP-hr).

[40CFR§60.4244(d)]

d. To determine compliance with the CO mass per unit output emission limitation, convert the concentration of CO in the engine exhaust using Equation 2 of this section:

$$ER = \frac{C_d \times 1.164 \times 10^{-3} \times Q \times T}{HP - hr} \qquad (Eq. 2)$$

Where:
ER = Emission rate of CO in g/HP-hr.

C_d= Measured CO concentration in ppmv.

1.164×10^{-3} = Conversion constant for ppm CO to grams per standard cubic meter at 20 degrees Celsius.

Q = Stack gas volumetric flow rate, in standard cubic meters per hour, dry basis.

T = Time of test run, in hours.

HP-hr = Brake work of the engine, in HP-hr.

[40CFR§60.4244(e)]

e. For purposes of this subpart, when calculating emissions of VOC, emissions of formaldehyde should not be included. To determine compliance with the VOC mass per unit output emission limitation, convert the concentration of VOC in the engine exhaust using Equation 3 of this section:

$$ER = \frac{C_d \times 1.833 \times 10^{-3} \times Q \times T}{HP - hr} \qquad (Eq. 3)$$

Where:
ER = Emission rate of VOC in g/HP-hr.

C_d= VOC concentration measured as propane in ppmv.

1.833×10^{-3} = Conversion constant for ppm VOC measured as propane, to grams per standard cubic meter at 20 degrees Celsius.

Q = Stack gas volumetric flow rate, in standard cubic meters per hour, dry basis.

T = Time of test run, in hours.

HP-hr = Brake work of the engine, in HP-hr.

[40CFR§60.4244(f)]

f. If the owner/operator chooses to measure VOC emissions using either Method 18 of 40 CFR part 60, appendix A, or Method 320 of 40 CFR part 63, appendix A, then it has the option of correcting the measured VOC emissions to account for the potential differences in measured values between these methods and Method 25A. The results from Method 18 and Method 320 can be corrected for response factor differences using Equations 4 and 5 of this section. The corrected VOC concentration can then be placed on a propane basis using Equation 6 of this section.

$$RF_i = \frac{C_{Mi}}{C_{Ai}} \qquad \text{(Eq. 4)}$$

Where:
RF_i= Response factor of compound i when measured with EPA Method 25A.

C_{Mi}= Measured concentration of compound i in ppmv as carbon.

C_{Ai}= True concentration of compound i in ppmv as carbon.

$$C_{icorr} = RF_i \times C_{imeas} \qquad \text{(Eq. 5)}$$

Where:
C_{icorr}= Concentration of compound i corrected to the value that would have been measured by EPA Method 25A, ppmv as carbon.

C_{imeas}= Concentration of compound i measured by EPA Method 320, ppmv as carbon.

$$C_{Peq} = 0.6098 \times C_{icorr} \qquad \text{(Eq. 6)}$$

Where:
C_{Peq}= Concentration of compound i in mg of propane equivalent per DSCM.

[40CFR§60.4244(g)]

8.5. Notification, Reports, and Records for Owners and Operators

8.5.1. Owners or operators of stationary SI ICE must meet the following notification, reporting and recordkeeping requirements.

a. Owners and operators of all stationary SI ICE must keep records of the information in paragraphs (a)(1) through (4) of this section.

1. All notifications submitted to comply with this subpart and all documentation supporting any notification.
2. Maintenance conducted on the engine.
3. If the stationary SI internal combustion engine is a certified engine, documentation from the manufacturer that the engine is certified to meet the emission standards and information as required in 40 CFR parts 90 and 1048.
4. If the stationary SI internal combustion engine is not a certified engine or is a certified engine operating in a non-certified manner and subject to §60.4243(a)(2), documentation that the engine meets the emission standards.

[40CFR§60.4245(a)]

b. For all stationary SI emergency ICE greater than or equal to 500 HP manufactured on or after July 1, 2010, that do not meet the standards applicable to non-emergency engines, the owner or operator of must keep records of the hours of operation of the engine that is recorded through the non-resettable hour meter. For all stationary SI emergency ICE greater than or equal to 130 HP and less than 500 HP manufactured on or after July 1, 2011 that do not meet the standards applicable to non-emergency engines, the owner or operator of must keep records of the hours of operation of the engine that is recorded through the non-resettable hour meter. For all stationary SI emergency ICE greater than 25 HP and less than 130 HP manufactured on or after July 1, 2008, that do not meet the standards applicable to non-emergency engines, the owner or operator of must keep records of the hours of operation of the engine that is recorded through the non-resettable hour meter. The owner or operator must document how many hours are spent for emergency operation, including what classified the operation as emergency and how many hours are spent for non-emergency operation. **[40CFR§60.4245(b)] (C-102, C-103, C-104)**

c. Owners and operators of stationary SI ICE greater than or equal to 500 HP that have not been certified by an engine manufacturer to meet the emission standards in §60.4231 must submit an initial notification as required in §60.7(a)(1). The notification must include the information in paragraphs (c)(1) through (5) of this section.

1. Name and address of the owner or operator;
2. The address of the affected source;
3. Engine information including make, model, engine family, serial number, model year, maximum engine power, and engine displacement;
4. Emission control equipment; and
5. Fuel used.

[40CFR§60.4245(c)] (C-102, C-103, C-104)

d. Owners and operators of stationary SI ICE that are subject to performance testing must submit a copy of each performance test as conducted in §60.4244 within 60 days after the test has been completed. **[40CFR§60.4245(d)]**

9.0. Source-Specific Requirements (40CFR60 Subpart IIII Requirements, Emergency Generators (M3-G-2, M3-G-3, M4-G-6, M4-G-7, M7-G-8, M7-G-9, MD1-G-4, MD2-G-10, MD1-G-5, MD2-G-11))

9.1. Limitations and Standards

9.1.1. **Emission Standards**
Owners and operators of 2007 model year and later emergency stationary CI ICE with a displacement of less than 30 liters per cylinder that are not fire pump engines must comply with the emission standards for new nonroad CI engines in §60.4202, for all pollutants, for the same model year and maximum engine power for their 2007 model year and later emergency stationary CI ICE. **[40CFR§60.4205d]**

9.1.2. Owners and operators of stationary CI ICE must operate and maintain stationary CI ICE that achieve the emission standards as required in §§60.4204 and 60.4205 over the entire life of the engine. **[40CFR§60.4206]**

9.1.3. **Fuel Requirements**
Beginning October 1, 2010, owners and operators of stationary CI ICE subject to this subpart with a displacement of less than 30 liters per cylinder that use diesel fuel must use diesel fuel that meets the requirements of 40 CFR 80.510(b) for nonroad diesel fuel. **[40CFR§60.4207b]**

9.1.4. In addition to the requirements specified in §§60.4201, 60.4202, 60.4204, and 60.4205, it is prohibited to import stationary CI ICE with a displacement of less than 30 liters per cylinder that do not meet the applicable requirements specified in paragraphs (a) through (g) of this section after the dates specified in paragraphs (a) through (g) of this section.. **[40CFR§60.4208h]**

9.1.5. If you are an owner or operator of an emergency stationary CI internal combustion engine that does not meet the standards applicable to non-emergency engines, you must install a non-resettable hour meter prior to startup of the engine. **[40CFR§60.4209a]**

9.1.6. If you are an owner or operator of a stationary CI internal combustion engine equipped with a diesel particulate filter to comply with the emission standards in §60.4204, the diesel particulate filter must be installed with a backpressure monitor that notifies the owner or operator when the high backpressure limit of the engine is approached. **[40CFR§60.4209b]**

9.1.7. If you are an owner or operator and must comply with the emission standards specified in this subpart, you must operate and maintain the stationary CI internal combustion engine and control device according to the manufacturer's written instructions or procedures developed by the owner or operator that are approved by the engine manufacturer. In addition, owners and operators may only change those settings that are permitted by the manufacturer. You must also meet the requirements of 40 CFR parts 89, 94 and/or 1068, as they apply to you. **[40CFR§60.4211a]**

9.1.8. If you are an owner or operator of a 2007 model year and later stationary CI internal combustion engine and must comply with the emission standards specified in §60.4204(b) or §60.4205(b), or if you are an owner or operator of a CI fire pump engine that is manufactured during or after the model year that applies to your fire pump engine power rating in table 3 to this subpart and must comply with the emission standards specified in §60.4205(c), you must comply by purchasing an engine certified to the emission standards in §60.4204(b), or §60.4205(b) or (c), as applicable, for the same model year and maximum (or in the case of fire pumps, NFPA nameplate) engine power. The engine must be installed and configured according to the manufacturer's specifications. **[40CFR§60.4211c]**

9.1.9. If you own or operate an emergency stationary ICE, you must operate the emergency stationary ICE according to the requirements in paragraphs (f)(1) through (3) of this section. In order for the

engine to be considered an emergency stationary ICE under this subpart, any operation other than emergency operation, maintenance and testing, emergency demand response, and operation in non-emergency situations for 50 hours per year, as described in paragraphs (f)(1) through (3) of this section, is prohibited. If you do not operate the engine according to the requirements in paragraphs (f)(1) through (3) of this section, the engine will not be considered an emergency engine under this subpart and must meet all requirements for non-emergency engines. **[40CFR§60.4211f]**

9.1.10. If you do not install, configure, operate, and maintain your engine and control device according to the manufacturer's emission-related written instructions, or you change emission-related settings in a way that is not permitted by the manufacturer, you must demonstrate compliance as follows:

(1) If you are an owner or operator of a stationary CI internal combustion engine with maximum engine power less than 100 HP, you must keep a maintenance plan and records of conducted maintenance to demonstrate compliance and must, to the extent practicable, maintain and operate the engine in a manner consistent with good air pollution control practice for minimizing emissions. In addition, if you do not install and configure the engine and control device according to the manufacturer's emission-related written instructions, or you change the emission-related settings in a way that is not permitted by the manufacturer, you must conduct an initial performance test to demonstrate compliance with the applicable emission standards within 1 year of such action.

(2) If you are an owner or operator of a stationary CI internal combustion engine greater than or equal to 100 HP and less than or equal to 500 HP, you must keep a maintenance plan and records of conducted maintenance and must, to the extent practicable, maintain and operate the engine in a manner consistent with good air pollution control practice for minimizing emissions. In addition, you must conduct an initial performance test to demonstrate compliance with the applicable emission standards within 1 year of startup, or within 1 year after an engine and control device is no longer installed, configured, operated, and maintained in accordance with the manufacturer's emission-related written instructions, or within 1 year after you change emission-related settings in a way that is not permitted by the manufacturer.

9.2. Testing Requirements

9.2.1. **Stack Testing**

At the time a stationary source is alleged to be in compliance with an applicable emission standard and at reasonable times to be determined by the Secretary thereafter, appropriate tests consisting of visual determinations or conventional in-stack measurements or other tests the Secretary may specify shall be conducted to determine compliance. For cause, the Secretary may request the permittee to install such stack gas monitoring devices as the Secretary deems necessary to determine continuing compliance. The data from such devices shall be readily available for review on-site or such other reasonable location that the Secretary may specify. At the request of the Secretary, such data shall be made available for inspection or copying and the Secretary may require periodic submission of excess emission reports (45CSR13).

9.2.1.a. All periodic tests to determine mass emission limits from or air pollutant concentrations in discharge stacks and such other tests as specified in this permit shall be conducted in accordance with an approved test protocol. Unless previously approved, such protocols shall be submitted to the Secretary in writing at least thirty (30) days prior to any testing and shall contain the information set forth by the Secretary. In addition, the permittee shall notify the Secretary at least fifteen (15) days prior to any testing so the Secretary may have the opportunity to observe such tests. This notification shall include the actual date and time during which the test will be conducted and, if appropriate, verification that the tests will fully conform to a referenced protocol previously approved by the Secretary. **[WV Code § 22-5-4(a)(15)]**

9.2.2. **Notification of Compliance Testing**
For any compliance test to be conducted by the permittee as set forth in this section, a test protocol shall be submitted to the Secretary at least thirty (30) calendar days prior to the scheduled date of the test. Such compliance test protocol shall be subject to approval by the Secretary. The permittee shall notify the Secretary at least fifteen (15) calendar days in advance of actual compliance test dates and times during which the test (or tests) will be conducted.

9.2.3. **Alternative Test Methods**
The Secretary may require a different test method or approve an alternative method in light of any technology advancements that may occur and may conduct such other tests as may be deem necessary to evaluate air pollution emissions.

9.2.4. Owners and operators of stationary CI ICE with a displacement of less than 30 liters per cylinder who conduct performance tests pursuant to this subpart must do so according to paragraphs (a) through (e) of this section. **[40CFR§60.4212]**

9.3. Recordkeeping and Reporting Requirements

9.3.1. **Monitoring Information**
The permittee shall keep the following records of monitoring information:

a. The date, place as defined in this permit and time of sampling measurements;
b. The date(s) analyses were performed;
c. The company or entity that performed the analyses;
d. The analytical techniques or methods used;
e. The results of the analyses; and
f. The operating conditions existing at the time of sampling or measurement.

9.3.2. **Equipment Maintenance Records**. The permittee shall maintain maintenance records relating to failure and/or repair of the emergency generators. In the event of equipment or system failure, these records shall document the permittee's effort to maintain proper and effective operation of such equipment and/or systems.

9.3.3. **Compliance Testing**
The permittee shall submit written reports of the results of all performance tests conducted to demonstrate compliance with the standards set forth in Section 9.0.

9.3.4. If the stationary CI internal combustion engine is an emergency stationary internal combustion engine, the owner or operator is not required to submit an initial notification. Starting with the model years in table 5 to this subpart, if the emergency engine does not meet the standards applicable to nonemergency engines in the applicable model year, the owner or operator must keep records of the operation of the engine in emergency and non-emergency service that are recorded through the non-resettable hour meter. The owner must record the time of operation of the engine and the reason the engine was in operation during that time. **[40CFR§60.4214b]**

9.3.5. If the stationary CI internal combustion engine is equipped with a diesel particulate filter, the owner or operator must keep records of any corrective action taken after the backpressure monitor has notified the owner or operator that the high backpressure limit of the engine is approached. **[40CFR§60.4214c]**

10.0. Source-Specific Requirements (40CFR63 Subpart ZZZZ Requirements, Engines and Emergency Generators)

10.1. Limitations and Standards

10.1.1. The permittee must comply with the applicable operating limitations in this section no later than October 19, 2013.
[40 C.F.R. § 63.6595(a)]

10.1.2. *Stationary RICE subject to Regulations under 40 CFR Part 60.* An affected source that meets any of the criteria in paragraphs (c)(1) through (7) of this section must meet the requirements of this part by meeting the requirements of 40 CFR part 60 subpart IIII, for compression ignition engines or 40 CFR part 60 subpart JJJJ, for spark ignition engines. No further requirements apply for such engines under this part.

The permittee meets the criteria of paragraph (c)(1), which is for a new or reconstructed stationary RICE located at an area source. The permittee must meet the requirements of this part by meeting the requirements of 40 CFR part 60 subpart JJJJ listed in Section 8.0 of this permit and 40 CFR part 60 subpart IIII listed in Section 9.0 of this permit.

11.0. Source-Specific Requirements (40CFR60 Subpart OOOO/OOOOa Requirements, Pneumatic Controllers)

11.1. Limitations and Standards

11.1.1. Each pneumatic controller affected facility at a natural gas processing plant must have a bleed rate of zero. Each pneumatic controller affected facility at a natural gas processing plant must be tagged with the month and year of installation, reconstruction or modification, and identification information that allows traceability to the records for that pneumatic controller as required in §60.5420a(c)(4)(iv).
[40CFR§60.5390(b)(1) & (b)(2) Majorsville I – VI]
[40CFR§60.5390a(b)(1) & (b)(2) Majorsville VII]

12.0. Source-Specific Requirements (40CFR60 Subpart KKK Requirements, Majorsville I & II)

12.1. Limitations and Standards

12.1.1. **Applicability and Designation of an Affected Facility.**

(a) (1) The provisions of this subpart apply to affected facilities in onshore natural gas processing plants.

(2) A compressor in VOC service or in wet gas service is an affected facility.

(3) The group of all equipment except compressors (defined in §60.631) within a process unit is an affected facility.

(b) Any affected facility under paragraph (a) of this section that commences construction, reconstruction, or modification after January 20, 1984, and on or before August 23, 2011, is subject to the requirements of this subpart.

(c) Addition or replacement of equipment (defined in §60.631) for the purpose of process improvement that is accomplished without a capital expenditure shall not by itself be considered a modification under this subpart.

(d) Facilities covered by subpart VV or subpart GGG of 40 CFR part 60 are excluded from this subpart.

(e) A compressor station, dehydration unit, sweetening unit, underground storage tank, field gas gathering system, or liquefied natural gas unit is covered by this subpart if it is located at an onshore natural gas processing plant. If the unit is not located at the plant site, then it is exempt from the provisions of this subpart.

[40 C.F.R. § 60.630]

12.1.2. **Standards.**

(a) Each owner or operator subject to the provisions of this subpart shall comply with the requirements of §§60.482-1 (a), (b), and (d) and 60.482-2 through 60.482-10, except as provided in §60.633, as soon as practicable, but no later than 180 days after initial startup.

(b) An owner or operator may elect to comply with the requirements of §§60.483-1 and 60.483-2.

(c) An owner or operator may apply to the Administrator for permission to use an alternative means of emission limitation that achieves a reduction in emissions of VOC at least equivalent to that achieved by the controls required in this subpart. In doing so, the owner or operator shall comply with requirements of §60.634 of this subpart.

(d) Each owner or operator subject to the provisions of this subpart shall comply with the provisions of §60.485 except as provided in §60.633(f) of this subpart.

(e) Each owner or operator subject to the provisions of this subpart shall comply with the provisions of §§60.486 and 60.487 except as provided in §§60.633, 60.635, and 60.636 of this subpart.

(f) An owner or operator shall use the following provision instead of §60.485(d)(1): Each piece of equipment is presumed to be in VOC service or in wet gas service unless an owner or operator demonstrates that the piece of equipment is not in VOC service or in wet gas service. For a piece of equipment to be considered not in VOC service, it must be determined that the VOC content can be reasonably expected never to exceed 10.0 percent by weight. For a piece

of equipment to be considered in wet gas service, it must be determined that it contains or contacts the field gas before the extraction step in the process. For purposes of determining the percent VOC content of the process fluid that is contained in or contacts a piece of equipment, procedures that conform to the methods described in ASTM E169-63, 77, or 93, E168-67, 77, or 92, or E260-73, 91, or 96 (incorporated by reference as specified in §60.17) shall be used.

[40 C.F.R. § 60.632]

12.1.3. **Exceptions.**

(a) Each owner or operator subject to the provisions of this subpart may comply with the following exceptions to the provisions of subpart VV.

(b) (1) Each pressure relief device in gas/vapor service may be monitored quarterly and within 5 days after each pressure release to detect leaks by the methods specified in §60.485(b) except as provided in §60.632(c), paragraph (b)(4) of this section, and §60.482-4 (a) through (c) of subpart VV.

(2) If an instrument reading of 10,000 ppm or greater is measured, a leak is detected.

(3) (i) When a leak is detected, it shall be repaired as soon as practicable, but no later than 15 calendar days after it is detected, except as provided in §60.482-9.

(ii) A first attempt at repair shall be made no later than 5 calendar days after each leak is detected.

(4) (i) Any pressure relief device that is located in a nonfractionating plant that is monitored only by nonplant personnel may be monitored after a pressure release the next time the monitoring personnel are on site, instead of within 5 days as specified in paragraph (b)(1) of this section and §60.482-4(b)(1) of subpart VV.

(ii) No pressure relief device described in paragraph (b)(4)(i) of this section shall be allowed to operate for more than 30 days after a pressure release without monitoring.

(c) Sampling connection systems are exempt from the requirements of §60.482-5.

(d) Pumps in light liquid service, valves in gas/vapor and light liquid service, and pressure relief devices in gas/vapor service that are located at a nonfractionating plant that does not have the design capacity to process 283,200 standard cubic meters per day (scmd) (10 million standard cubic feet per day) or more of field gas are exempt from the routine monitoring requirements of §§60.482-2(a)(1) and 60.482-7(a), and paragraph (b)(1) of this section.

(e) Pumps in light liquid service, valves in gas/vapor and light liquid service, and pressure relief devices in gas/vapor service within a process unit that is located in the Alaskan North Slope are exempt from the routine monitoring requirements of §§60.482-2(a)(1), 60.482-7(a), and paragraph (b)(1) of this section.

(f) *Reserved.*

(g) Flares used to comply with this subpart shall comply with the requirements of §60.18.

(h) An owner or operator may use the following provisions instead of §60.485(e):

(1) Equipment is in heavy liquid service if the weight percent evaporated is 10 percent or less at 150 °C (302 °F) as determined by ASTM Method D86-78, 82, 90, 95, or 96 (incorporated by reference as specified in §60.17).

(2) Equipment is in light liquid service if the weight percent evaporated is greater than 10 percent at 150 °C (302 °F) as determined by ASTM Method D86-78, 82, 90, 95, or 96 (incorporated by reference as specified in §60.17).

[40 C.F.R. § 60.633]

12.1.4. **Alternative Means of Emission Limitation.**

(a) If, in the Administrator's judgment, an alternative means of emission limitation will achieve a reduction in VOC emissions at least equivalent to the reduction in VOC emissions achieved under any design, equipment, work practice or operational standard, the Administrator will publish, in the Federal Register a notice permitting the use of that alternative means for the purpose of compliance with that standard. The notice may condition permission on requirements related to the operation and maintenance of the alternative means.

(b) Any notice under paragraph (a) of this section shall be published only after notice and an opportunity for a public hearing.

(c) The Administrator will consider applications under this section from either owners or operators of affected facilities, or manufacturers of control equipment.

(d) The Administrator will treat applications under this section according to the following criteria, except in cases where he concludes that other criteria are appropriate:

(1) The applicant must collect, verify and submit test data, covering a period of at least 12 months, necessary to support the finding in paragraph (a) of this section.

(2) If the applicant is an owner or operator of an affected facility, he must commit in writing to operate and maintain the alternative means so as to achieve a reduction in VOC emissions at least equivalent to the reduction in VOC emissions achieved under the design, equipment, work practice or operational standard.

[40 C.F.R. § 60.634]

12.2. Notification, Recordkeeping and Reporting Requirements

12.2.1. **Majorsville I & II Recordkeeping Requirements.**

(a) Each owner or operator subject to the provisions of this subpart shall comply with the requirements of paragraphs (b) and (c) of this section in addition to the requirements of §60.486.

(b) The following recordkeeping requirements shall apply to pressure relief devices subject to the requirements of §60.633(b)(1) of this subpart.

(1) When each leak is detected as specified in §60.633(b)(2), a weatherproof and readily visible identification, marked with the equipment identification number, shall be attached to the leaking equipment. The identification on the pressure relief device may be removed after it has been repaired.

(2) When each leak is detected as specified in §60.633(b)(2), the following information shall be recorded in a log and shall be kept for 2 years in a readily accessible location:

(i) The instrument and operator identification numbers and the equipment identification number.

(ii) The date the leak was detected and the dates of each attempt to repair the leak.

(iii) Repair methods applied in each attempt to repair the leak.

(iv) "Above 10,000 ppm" if the maximum instrument reading measured by the methods specified in paragraph (a) of this section after each repair attempt is 10,000 ppm or greater.

(v) "Repair delayed" and the reason for the delay if a leak is not repaired within 15 calendar days after discovery of the leak.

(vi) The signature of the owner or operator (or designate) whose decision it was that repair could not be effected without a process shutdown.

(vii) The expected date of successful repair of the leak if a leak is not repaired within 15 days.

(viii) Dates of process unit shutdowns that occur while the equipment is unrepaired.

(ix) The date of successful repair of the leak.

(x) A list of identification numbers for equipment that are designated for no detectable emissions under the provisions of §60.482-4(a). The designation of equipment subject to the provisions of §60.482-4(a) shall be signed by the owner or operator.

(c) An owner or operator shall comply with the following requirement in addition to the requirement of §60.486(j): Information and data used to demonstrate that a reciprocating compressor is in wet gas service to apply for the exemption in §60.633(f) shall be recorded in a log that is kept in a readily accessible location.

[40 C.F.R. § 60.635]

12.2.2. **Majorsville I & II Reporting Requirements.**

(a) Each owner or operator subject to the provisions of this subpart shall comply with the requirements of paragraphs (b) and (c) of this section in addition to the requirements of §60.487.

(b) An owner or operator shall include the following information in the initial semiannual report in addition to the information required in §60.487(b) (1)-(4): Number of pressure relief devices subject to the requirements of §60.633(b) except for those pressure relief devices designated for no detectable emissions under the provisions of §60.482-4(a) and those pressure relief devices complying with §60.482-4(c).

(c) An owner or operator shall include the following information in all semiannual reports in addition to the information required in §60.487(c)(2) (i) through (vi):

(1) Number of pressure relief devices for which leaks were detected as required in §60.633(b)(2) and

(2) Number of pressure relief devices for which leaks were not repaired as required in §60.633(b)(3).

[40 C.F.R. § 60.636]

13.0. Source-Specific Requirements (40CFR60 Subpart OOOO Requirements, Majorsville III – VI, DeEthanizer I)

13.1. Limitations and Standards

13.1.1. The permittee must be in compliance with the standards of this subpart no later than October 15, 2012 or upon startup, whichever is later.
[40 C.F.R. § 60.5370(a)]

13.1.2. The permittee is exempt from the obligation to obtain a permit under 40 CFR part 70 or 40 CFR part 71, provided you are not otherwise required by law to obtain a permit under 40 CFR 70.3(a) or 40 CFR 71.3(a). Notwithstanding the previous sentence, you must continue to comply with the provisions of this subpart.
[40 C.F.R. § 60.5370(c)]

13.1.3. **Majorsville III - VI Equipment Leak Standards.**
This section applies to the group of all equipment, except compressors, within a process unit.

(a) You must comply with the requirements of §§60.482-1a(a), (b), and (d), 60.482-2a, and 60.482-4a through 60.482-11a, except as provided in §60.5401.

(b) You may elect to comply with the requirements of §§60.483-1a and 60.483-2a, as an alternative.

(c) You may apply to the Administrator for permission to use an alternative means of emission limitation that achieves a reduction in emissions of VOC at least equivalent to that achieved by the controls required in this subpart according to the requirements of §60.5402 of this subpart.

(d) You must comply with the provisions of §60.485a of this part except as provided in paragraph (f) of this section.

(e) You must comply with the provisions of §§60.486a and 60.487a of this part except as provided in §§60.5401, 60.5421, and 60.5422 of this part.

(f) You must use the following provision instead of §60.485a(d)(1): Each piece of equipment is presumed to be in VOC service or in wet gas service unless an owner or operator demonstrates that the piece of equipment is not in VOC service or in wet gas service. For a piece of equipment to be considered not in VOC service, it must be determined that the VOC content can be reasonably expected never to exceed 10.0 percent by weight. For a piece of equipment to be considered in wet gas service, it must be determined that it contains or contacts the field gas before the extraction step in the process. For purposes of determining the percent VOC content of the process fluid that is contained in or contacts a piece of equipment, procedures that conform to the methods described in ASTM E169-93, E168-92, or E260-96 (incorporated by reference as specified in §60.17) must be used.
[40 C.F.R. § 60.5400]

13.1.4. **Exceptions to the Majorsville III - VI Equipment Leak Standards.**
(a) You may comply with the following exceptions to the provisions of §60.5400(a) and (b).

(b) (1) Each pressure relief device in gas/vapor service may be monitored quarterly and within 5 days after each pressure release to detect leaks by the methods specified in §60.485a(b) except as provided in §60.5400(c) and in paragraph (b)(4) of this section, and §60.482-4a(a) through (c) of subpart VVa.

(2) If an instrument reading of 500 ppm or greater is measured, a leak is detected.

(3) (i) When a leak is detected, it must be repaired as soon as practicable, but no later than 15 calendar days after it is detected, except as provided in §60.482-9a.

(ii) A first attempt at repair must be made no later than 5 calendar days after each leak is detected.

(4) (i) Any pressure relief device that is located in a nonfractionating plant that is monitored only by non-plant personnel may be monitored after a pressure release the next time the monitoring personnel are on-site, instead of within 5 days as specified in paragraph (b)(1) of this section and §60.482-4a(b)(1) of subpart VVa.

(ii) No pressure relief device described in paragraph (b)(4)(i) of this section must be allowed to operate for more than 30 days after a pressure release without monitoring.

(c) Sampling connection systems are exempt from the requirements of §60.482-5a.

(d) Pumps in light liquid service, valves in gas/vapor and light liquid service, and pressure relief devices in gas/vapor service that are located at a nonfractionating plant that does not have the design capacity to process 283,200 standard cubic meters per day (scmd) (10 million standard cubic feet per day) or more of field gas are exempt from the routine monitoring requirements of §§60.482-2a(a)(1) and 60.482-7a(a), and paragraph (b)(1) of this section.

(e) Pumps in light liquid service, valves in gas/vapor and light liquid service, and pressure relief devices in gas/vapor service within a process unit that is located in the Alaskan North Slope are exempt from the routine monitoring requirements of §§60.482-2a(a)(1), 60.482-7a(a), and paragraph (b)(1) of this section.

(f) An owner or operator may use the following provisions instead of §60.485a(e):

(1) Equipment is in heavy liquid service if the weight percent evaporated is 10 percent or less at 150 °C (302 °F) as determined by ASTM Method D86-96 (incorporated by reference as specified in §60.17).

(2) Equipment is in light liquid service if the weight percent evaporated is greater than 10 percent at 150 °C (302 °F) as determined by ASTM Method D86-96 (incorporated by reference as specified in §60.17).

(g) An owner or operator may use the following provisions instead of §60.485a(b)(2): A calibration drift assessment shall be performed, at a minimum, at the end of each monitoring day. Check the instrument using the same calibration gas(es) that were used to calibrate the instrument before use. Follow the procedures specified in Method 21 of appendix A-7 of this part, Section 10.1, except do not adjust the meter readout to correspond to the calibration gas value. Record the instrument reading for each scale used as specified in §60.486a(e)(8). Divide these readings by the initial calibration values for each scale and multiply by 100 to express the calibration drift as a percentage. If any calibration drift assessment shows a negative drift of more than 10 percent from the initial calibration value, then all equipment monitored since the last calibration with instrument readings below the appropriate leak definition and above the leak definition multiplied by (100 minus the percent of negative drift/divided by 100) must be re-monitored. If any calibration drift assessment shows a positive drift of more than 10 percent from the initial calibration value, then, at the owner/operator's discretion, all equipment since the last calibration with instrument readings above the appropriate leak definition and below the leak definition multiplied by (100 plus the percent of positive drift/divided by 100) may be re-monitored.

[40 C.F.R. § 60.5401]

13.1.5. **Alternative Emission Limitations for Equipment Leaks at Majorsville III - VI.**

(a) If, in the Administrator's judgment, an alternative means of emission limitation will achieve a reduction in VOC emissions at least equivalent to the reduction in VOC emissions achieved under any design, equipment, work practice or operational standard, the Administrator will publish, in the Federal Register, a notice permitting the use of that alternative means for the purpose of compliance with that standard. The notice may condition permission on requirements related to the operation and maintenance of the alternative means.

(b) Any notice under paragraph (a) of this section must be published only after notice and an opportunity for a public hearing.

(c) The Administrator will consider applications under this section from either owners or operators of affected facilities, or manufacturers of control equipment.

(d) The Administrator will treat applications under this section according to the following criteria, except in cases where the Administrator concludes that other criteria are appropriate:

(1) The applicant must collect, verify and submit test data, covering a period of at least 12 months, necessary to support the finding in paragraph (a) of this section.

(2) If the applicant is an owner or operator of an affected facility, the applicant must commit in writing to operate and maintain the alternative means so as to achieve a reduction in VOC emissions at least equivalent to the reduction in VOC emissions achieved under the design, equipment, work practice or operational standard.

[40 C.F.R. § 60.5402]

13.2. Initial Compliance Demonstration

13.2.1. You must determine initial compliance with the standards for each affected facility using the requirements in paragraph (f) of this section. The initial compliance period begins on October 15, 2012 or upon initial startup, whichever is later, and ends no later than one year after the initial startup date for your affected facility or no later than one year after October 15, 2012. The initial compliance period may be less than one full year.

(f). For affected facilities at onshore natural gas processing plants, initial compliance with the VOC requirements is demonstrated if you are in compliance with the requirements of § 60.5400.

[40CFR§60.5410, Majorsville III - VI]

13.3. Continuous Compliance Demonstration

13.3.1. For affected facilities at onshore natural gas processing plants, continuous compliance with VOC requirements is demonstrated if you are in compliance with the requirements of § 60.5400.
[40CFR§60.5415, Majorsville III - VI]

13.4. Notification, Recordkeeping and Reporting Requirements

13.4.1. **Majorsville III - VI Additional Recordkeeping Requirements.**

(a) You must comply with the requirements of paragraph (b) of this section in addition to the requirements of §60.486a.

(b) The following recordkeeping requirements apply to pressure relief devices subject to the requirements of §60.5401(b)(1) of this subpart.

(1) When each leak is detected as specified in §60.5401(b)(2), a weatherproof and readily visible identification, marked with the equipment identification number, must be attached to the leaking equipment. The identification on the pressure relief device may be removed after it has been repaired.

(2) When each leak is detected as specified in §60.5401(b)(2), the following information must be recorded in a log and shall be kept for 2 years in a readily accessible location:

(i) The instrument and operator identification numbers and the equipment identification number.

(ii) The date the leak was detected and the dates of each attempt to repair the leak.

(iii) Repair methods applied in each attempt to repair the leak.

(iv) "Above 500 ppm" if the maximum instrument reading measured by the methods specified in paragraph (a) of this section after each repair attempt is 500 ppm or greater.

(v) "Repair delayed" and the reason for the delay if a leak is not repaired within 15 calendar days after discovery of the leak.

(vi) The signature of the owner or operator (or designate) whose decision it was that repair could not be effected without a process shutdown.

(vii) The expected date of successful repair of the leak if a leak is not repaired within 15 days.

(viii) Dates of process unit shutdowns that occur while the equipment is unrepaired.

(ix) The date of successful repair of the leak.

(x) A list of identification numbers for equipment that are designated for no detectable emissions under the provisions of §60.482-4a(a). The designation of equipment subject to the provisions of §60.482-4a(a) must be signed by the owner or operator.

[40CFR§60.5421, Majorsville III - VI]

13.4.3. **Majorsville III - VI Additional Reporting Requirements.**

(a) You must comply with the requirements of paragraphs (b) and (c) of this section in addition to the requirements of §60.487a(a), (b), (c)(2)(i) through (iv), and (c)(2)(vii) through (viii).

(b) An owner or operator must include the following information in the initial semiannual report in addition to the information required in §60.487a(b)(1) through (4): Number of pressure relief devices subject to the requirements of §60.5401(b) except for those pressure relief devices designated for no detectable emissions under the provisions of §60.482-4a(a) and those pressure relief devices complying with §60.482-4a(c).

(c) An owner or operator must include the following information in all semiannual reports in addition to the information required in §60.487a(c)(2)(i) through (vi):

(1) Number of pressure relief devices for which leaks were detected as required in §60.5401(b)(2); and

(2) Number of pressure relief devices for which leaks were not repaired as required in §60.5401(b)(3).

[40CFR§60.5422, Majorsville III - VI]

14.0. Source-Specific Requirements (40CFR60 Subpart OOOOa Requirements, Majorsville VII, DeEthanizer II)

14.1. Limitations and Standards

14.1.1. The permittee must be in compliance with the standards of this subpart no later than August 2, 2016 or upon startup, whichever is later.
[40 C.F.R. § 60.5370a(a)]

14.1.2. At all times, including periods of startup, shutdown, and malfunction, owners and operators shall maintain and operate any affected facility including associated air pollution control equipment in a manner consistent with good air pollution control practice for minimizing emissions. Determination of whether acceptable operating and maintenance procedures are being used will be based on information available to the Administrator which may include, but is not limited to, monitoring results, opacity observations, review of operating and maintenance procedures, and inspection of the source. The provisions for exemption from compliance during periods of startup, shutdown and malfunctions provided for in 40 CFR 60.8(c) do not apply to this subpart.
[40 C.F.R. § 60.5370a(b)]

14.1.3. The permittee is exempt from the obligation to obtain a permit under 40 CFR part 70 or 40 CFR part 71, provided you are not otherwise required by law to obtain a permit under 40 CFR 70.3(a) or 40 CFR 71.3(a). Notwithstanding the previous sentence, you must continue to comply with the provisions of this subpart.
[40 C.F.R. § 60.5370a(c)]

14.1.4. **Majorsville VII Equipment Leak Standards.**
This section applies to the group of all equipment, except compressors, within a process unit.

(a) You must comply with the requirements of §§60.482-1a(a), (b), and (d), 60.482-2a, and 60.482-4a through 60.482-11a, except as provided in §60.5401a.

(b) You may elect to comply with the requirements of §§60.483-1a and 60.483-2a, as an alternative.

(c) You may apply to the Administrator for permission to use an alternative means of emission limitation that achieves a reduction in emissions of methane and VOC at least equivalent to that achieved by the controls required in this subpart according to the requirements of §60.5402a.

(d) You must comply with the provisions of §60.485a of this part except as provided in paragraph (f) of this section.

(e) You must comply with the provisions of §§60.486a and 60.487a of this part except as provided in §§60.5401a, 60.5421a, and 60.5422a of this part.

(f) You must use the following provision instead of §60.485a(d)(1): Each piece of equipment is presumed to be in VOC service or in wet gas service unless an owner or operator demonstrates that the piece of equipment is not in VOC service or in wet gas service. For a piece of equipment to be considered not in VOC service, it must be determined that the VOC content can be reasonably expected never to exceed 10.0 percent by weight. For a piece of equipment to be considered in wet gas service, it must be determined that it contains or contacts the field gas before the extraction step in the process. For purposes of determining the percent VOC content of the process fluid that is contained in or contacts a piece of equipment, procedures that conform to the methods described in ASTM E169-93, E168-92, or E260-96 (incorporated by reference as specified in §60.17) must be used.

[40 C.F.R. § 60.5400a]

14.1.5. **Exceptions to the Majorsville VII Equipment Leak Standards.**
(a) You may comply with the following exceptions to the provisions of §60.5400a(a) and (b).

(b) (1) Each pressure relief device in gas/vapor service may be monitored quarterly and within 5 days after each pressure release to detect leaks by the methods specified in §60.485a(b) except as provided in §60.5400a(c) and in paragraph (b)(4) of this section, and §60.482-4a(a) through (c) of subpart VVa.

(2) If an instrument reading of 500 ppm or greater is measured, a leak is detected.

(3) (i) When a leak is detected, it must be repaired as soon as practicable, but no later than 15 calendar days after it is detected, except as provided in §60.482-9a.

(ii) A first attempt at repair must be made no later than 5 calendar days after each leak is detected.

(4) (i) Any pressure relief device that is located in a nonfractionating plant that is monitored only by non-plant personnel may be monitored after a pressure release the next time the monitoring personnel are on-site, instead of within 5 days as specified in paragraph (b)(1) of this section and §60.482-4a(b)(1) of subpart VVa.

(ii) No pressure relief device described in paragraph (b)(4)(i) of this section must be allowed to operate for more than 30 days after a pressure release without monitoring.

(c) Sampling connection systems are exempt from the requirements of §60.482-5a.

(d) Pumps in light liquid service, valves in gas/vapor and light liquid service, and pressure relief devices in gas/vapor service that are located at a nonfractionating plant that does not have the design capacity to process 283,200 standard cubic meters per day (scmd) (10 million standard cubic feet per day) or more of field gas are exempt from the routine monitoring requirements of §§60.482-2a(a)(1) and 60.482-7a(a), and paragraph (b)(1) of this section.

(e) Pumps in light liquid service, valves in gas/vapor and light liquid service, and pressure relief devices in gas/vapor service within a process unit that is located in the Alaskan North Slope are exempt from the routine monitoring requirements of §§60.482-2a(a)(1), 60.482-7a(a), and paragraph (b)(1) of this section.

(f) An owner or operator may use the following provisions instead of §60.485a(e):

(1) Equipment is in heavy liquid service if the weight percent evaporated is 10 percent or less at 150 °C (302 °F) as determined by ASTM Method D86-96 (incorporated by reference as specified in §60.17).

(2) Equipment is in light liquid service if the weight percent evaporated is greater than 10 percent at 150 °C (302 °F) as determined by ASTM Method D86-96 (incorporated by reference as specified in §60.17).

(g) An owner or operator may use the following provisions instead of §60.485a(b)(2): A calibration drift assessment shall be performed, at a minimum, at the end of each monitoring day. Check the instrument using the same calibration gas(es) that were used to calibrate the instrument before use. Follow the procedures specified in Method 21 of appendix A-7 of this part, Section 10.1, except do not adjust the meter readout to correspond to the calibration gas value. Record the instrument reading for each scale used as specified in §60.486a(e)(8). Divide these readings by the initial calibration values for each scale and multiply by 100 to

express the calibration drift as a percentage. If any calibration drift assessment shows a negative drift of more than 10 percent from the initial calibration value, then all equipment monitored since the last calibration with instrument readings below the appropriate leak definition and above the leak definition multiplied by (100 minus the percent of negative drift/divided by 100) must be re-monitored. If any calibration drift assessment shows a positive drift of more than 10 percent from the initial calibration value, then, at the owner/operator's discretion, all equipment since the last calibration with instrument readings above the appropriate leak definition and below the leak definition multiplied by (100 plus the percent of positive drift/divided by 100) may be re-monitored.

[40 C.F.R. § 60.5401a]

14.1.6. **Alternative Emission Limitations for Equipment Leaks at Majorsville VII.**

(a) If, in the Administrator's judgment, an alternative means of emission limitation will achieve a reduction in GHG and VOC emissions at least equivalent to the reduction in GHG and VOC emissions achieved under any design, equipment, work practice or operational standard, the Administrator will publish, in the Federal Register, a notice permitting the use of that alternative means for the purpose of compliance with that standard. The notice may condition permission on requirements related to the operation and maintenance of the alternative means.

(b) Any notice under paragraph (a) of this section must be published only after notice and an opportunity for a public hearing.

(c) The Administrator will consider applications under this section from either owners or operators of affected facilities, or manufacturers of control equipment.

(d) The Administrator will treat applications under this section according to the following criteria, except in cases where the Administrator concludes that other criteria are appropriate:

(1) The applicant must collect, verify and submit test data, covering a period of at least 12 months, necessary to support the finding in paragraph (a) of this section.

(2) The application must include operation, maintenance and other provisions necessary to assure reduction in methane and VOC emissions at least equivalent to the reduction in methane and VOC emissions achieved under the design, equipment, work practice or operational standard in paragraph (a) of this section by including the information specified in paragraphs (d)(1)(i) through (x) of this section.

(i) A description of the technology or process.

(ii) The monitoring instrument and measurement technology or process.

(iii) A description of performance based procedures (i.e. method) and data quality indicators for precision and bias; the method detection limit of the technology or process.

(iv) The action criteria and level at which a fugitive emission exists.

(v) Any initial and ongoing quality assurance/quality control measures.

(vi) Timeframes for conducting ongoing quality assurance/quality control.

(vii) Field data verifying viability and detection capabilities of the technology or process.

(viii) Frequency of measurements.

(ix) Minimum data availability.

(x) Any restrictions for using the technology or process.

(3) The application must include initial and continuous compliance procedures including recordkeeping and reporting.

[40 C.F.R. § 60.5402a]

14.2. Initial Compliance Demonstration

14.2.1. You must determine initial compliance with the standards for each affected facility using the requirements in paragraph (f) of this section. The initial compliance period begins on August 2, 2016, or upon initial startup, whichever is later, and ends no later than 1 year after the initial startup date for your affected facility or no later than 1 year after August 2, 2016. The initial compliance period may be less than one full year.

(f). For affected facilities at onshore natural gas processing plants, initial compliance with the methane and VOC standards is demonstrated if you are in compliance with the requirements of §60.5400a.

[40CFR§60.5410a, Majorsville VII]

14.3. Continuous Compliance Demonstration

14.3.1. For affected facilities at onshore natural gas processing plants, continuous compliance with methane and VOC requirements is demonstrated if you are in compliance with the requirements of §60.5400a.

[40CFR§60.5415a, Majorsville VII]

14.4. Notification, Recordkeeping and Reporting Requirements

14.4.1. **Majorsville VII Additional Recordkeeping Requirements.**

(a) You must comply with the requirements of paragraph (b) of this section in addition to the requirements of §60.486a.

(b) The following recordkeeping requirements apply to pressure relief devices subject to the requirements of §60.5401a(b)(1) of this subpart.

(1) When each leak is detected as specified in §60.5401a(b)(2), a weatherproof and readily visible identification, marked with the equipment identification number, must be attached to the leaking equipment. The identification on the pressure relief device may be removed after it has been repaired.

(2) When each leak is detected as specified in §60.5401a(b)(2), the information specified in paragraphs (b)(2)(i) through (x) of this section must be recorded in a log and shall be kept for 2 years in a readily accessible location:

(i) The instrument and operator identification numbers and the equipment identification number.

(ii) The date the leak was detected and the dates of each attempt to repair the leak.

(iii) Repair methods applied in each attempt to repair the leak.

(iv) "Above 500 ppm" if the maximum instrument reading measured by the methods specified in paragraph (a) of this section after each repair attempt is 500 ppm or greater.

(v) "Repair delayed" and the reason for the delay if a leak is not repaired within 15 calendar days after discovery of the leak.

(vi) The signature of the owner or operator (or designate) whose decision it was that repair could not be effected without a process shutdown.

(vii) The expected date of successful repair of the leak if a leak is not repaired within 15 days.

(viii) Dates of process unit shutdowns that occur while the equipment is unrepaired.

(ix) The date of successful repair of the leak.

(x) A list of identification numbers for equipment that are designated for no detectable emissions under the provisions of §60.482-4a(a). The designation of equipment subject to the provisions of §60.482-4a(a) must be signed by the owner or operator.

[40CFR§60.5421a, Majorsville VII]

14.4.2. **Majorsville VII Additional Reporting Requirements.**

(a) You must comply with the requirements of paragraphs (b) and (c) of this section in addition to the requirements of §60.487a(a), (b), (c)(2)(i) through (iv), and (c)(2)(vii) through (viii). You must submit semiannual reports to the EPA via the Compliance and Emissions Data Reporting Interface (CEDRI). (CEDRI can be accessed through the EPA's Central Data Exchange (CDX) (https://cdx.epa.gov/).) Use the appropriate electronic report in CEDRI for this subpart or an alternate electronic file format consistent with the extensible markup language (XML) schema listed on the CEDRI Web site (https://www3.epa.gov/ttn/chief/cedri/). If the reporting form specific to this subpart is not available in CEDRI at the time that the report is due, submit the report to the Administrator at the appropriate address listed in §60.4. Once the form has been available in CEDRI for at least 90 days, you must begin submitting all subsequent reports via CEDRI. The report must be submitted by the deadline specified in this subpart, regardless of the method in which the report is submitted.

(b) An owner or operator must include the following information in the initial semiannual report in addition to the information required in §60.487a(b)(1) through (4): Number of pressure relief devices subject to the requirements of §60.5401a(b) except for those pressure relief devices designated for no detectable emissions under the provisions of §60.482-4a(a) and those pressure relief devices complying with §60.482-4a(c).

(c) An owner or operator must include the following information in all semiannual reports in addition to the information required in §60.487a(c)(2)(i) through (vi):

(1) Number of pressure relief devices for which leaks were detected as required in §60.5401a(b)(2); and

(2) Number of pressure relief devices for which leaks were not repaired as required in §60.5401a(b)(3).

[40CFR§60.5422a, Majorsville VII]

CERTIFICATION OF DATA ACCURACY

I, the undersigned, hereby certify that, based on information and belief formed after reasonable inquiry, all information contained in the attached _____, representing the period beginning _____ and ending _____, and any supporting documents appended hereto, is true, accurate, and complete.

Signature[1] (please use blue ink) _____ Responsible Official or Authorized Representative _____ Date

Name & Title (please print or type) _____ Name _____ Title

Telephone No. _____ Fax No. _____

[1] This form shall be signed by a "Responsible Official." "Responsible Official" means one of the following:

a. For a corporation: The president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation, or a duly authorized representative of such person if the representative is responsible for the overall operation of one or more manufacturing, production, or operating facilities applying for or subject to a permit and either:

(i) the facilities employ more than 250 persons or have a gross annual sales or expenditures exceeding $25 million (in second quarter 1980 dollars), or

(ii) the delegation of authority to such representative is approved in advance by the Director;

b. For a partnership or sole proprietorship: a general partner or the proprietor, respectively;

c. For a municipality, State, Federal, or other public entity: either a principal executive officer or ranking elected official. For the purposes of this part, a principal executive officer of a Federal agency includes the chief executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., a Regional Administrator of U.S. EPA); or

d. The designated representative delegated with such authority and approved in advance by the Director.

Williams, Jerry

From: Wade Janecek <Wade.Janecek@markwest.com>
Sent: Monday, January 23, 2017 5:48 PM
To: Williams, Jerry
Subject: RE: Majorsville Gas Plant Air Permit
Attachments: Emissions Calculation Updates.pdf

Jerry,

Apologize for the late response I'm out of the office today. I've attached GHG calcs for the pigging operations. With regard to H-6782. The unit was never installed which is why I left it out of this application (but apparently missed it when I went through the GHG table and header for the calc sheet). I've removed it from the calc sheet as well as from the GHG summary pages (updated sheets attached). Please let me know if you need anything else.

Wade Janecek
Senior Environmental Engineer
MarkWest Energy Partners, L.P.
1515 Arapahoe Street | Tower 1 - Suite 1600 | Denver, CO 80202
Direct: (303) 542-1212 Ext. 1512 | Cell: (970) 270-5584
Email: Wade.Janecek@MarkWest.com

From: Williams, Jerry [mailto:Jerry.Williams@wv.gov]
Sent: Monday, January 23, 2017 11:06 AM
To: Wade Janecek
Subject: Majorsville Gas Plant Air Permit

Wade,

In regards to the air permit application for Majorsville:

1. Please provide the GHG (CO2e) emissions for the pigging operations.
2. What is heater H-6782? It is not included on Attachment I (Emissions Unit Table) nor the facility wide emissions table (criteria and HAP emissions), but an individual calculation sheet is included for it and you did include it in your facility wide GHG. Please let me know if this exists.

This information is needed for me to continue my review.

Thanks
Jerry

Jerry Williams, P.E.
Engineer
WVDEP – Division of Air Quality
601 57th Street, SE
Charleston, WV 25304
(304) 926-0499 ext. 1223
jerry.williams@wv.gov

ID # 051-00125
Reg R13-2818G
Company MARKWEST
Facility MAJORSVILLE Initials JW

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GHG Calculations
MarkWest Liberty Midstream & Resources L.L.C.
Majorsville Gas Plant

Source	$CO_2(e)$ CO_2 Emission Rate (tpy)	$CO_2(e)$ CH_4 Emission Rate (tpy)	$CO_2(e)$ N_2O Emission Rate (tpy)
Reboiler/Heaters & Flares	220,618.78	87.38	128.99
Natural gas Engines	27,376.74	10.84	16.01
Diesel Engines	994.57	0.85	2.50
Fugitives	0.13	553.27	-
Blowdown Emissions	0.80	2,841.50	-
Pigging	0.13	11.40	-
Total Emissions	**248,991.15**	**3,505.25**	**147.50**

Total CO_2 Equivalent	**252,643.89**

GHG Calculations
MarkWest Liberty Midstream & Resources L.L.C.
Majorsville Gas Plant

Reboiler/Heaters & Flares

Equipment	Heat Input (LHV) (mmbtu/hr)	Heat Input (HHV) (mmbtu/hr)	Emission Factors CO_2 (lb/mmbtu)	Emission Factors CH_4 (lb/mmbtu)	Emission Factors N_2O (lb/mmbtu)	$CO_2(e)$ CO_2 Emission Rate (tpy)	$CO_2(e)$ CH_4 Emission Rate (tpy)	$CO_2(e)$ N_2O Emission Rate (tpy)
Flare Pilot F-991	0.5100	0.5610	116.887892	0.0022046	0.00022046	287.21	0.11	0.17
Flare Pilot F-1991	0.43	0.4675	116.887892	0.0022046	0.00022046	239.35	0.09	0.14
Heater H-741	5.60	6.1600	116.887892	0.0022046	0.00022046	3,153.73	1.25	1.84
Heater H-2741	5.60	6.1600	116.887892	0.0022046	0.00022046	3,153.73	1.25	1.84
Heater H-3741	7.69	8.4590	116.887892	0.0022046	0.00022046	4,330.75	1.72	2.53
Heater H-4741	7.69	8.4590	116.887892	0.0022046	0.00022046	4,330.75	1.72	2.53
Heater H-5741	7.69	8.4590	116.887892	0.0022046	0.00022046	4,330.75	1.72	2.53
Heater H-6741	7.69	8.4590	116.887892	0.0022046	0.00022046	4,330.75	1.72	2.53
Heater H-7741	7.69	8.4590	116.887892	0.0022046	0.00022046	4,330.75	1.72	2.53
Heater H-781	15.40	16.9400	116.887892	0.0022046	0.00022046	8,672.75	3.44	5.07
Heater H-3781	16.07	17.6770	116.887892	0.0022046	0.00022046	9,050.08	3.58	5.29
Heater H-4781	16.07	17.6770	116.887892	0.0022046	0.00022046	9,050.08	3.58	5.29
Heater H-7781	16.07	17.6770	116.887892	0.0022046	0.00022046	9,050.08	3.58	5.29
Heater H-1782	119.20	131.1200	116.887892	0.0022046	0.00022046	67,129.37	26.59	39.25
Heater H-D2782	119.20	131.1200	116.887892	0.0022046	0.00022046	67,129.37	26.59	39.25
Heater H-1741	14.25	15.6750	116.887892	0.0022046	0.00022046	8,025.11	3.18	4.69
Heater H-D2741	14.25	15.6750	116.887892	0.0022046	0.00022046	8,025.11	3.18	4.69
Heater H-4782	10.65	11.7177	116.887892	0.0022046	0.00022046	5,999.09	2.38	3.51
Total						220,618.78	87.38	128.99

Natural gas Engines

Equipment	HP	Fuel Use (HHV) (btu/bhp-hr)	Fuel Use (HHV) (mmbtu/yr)	Emission Factors CO_2 (lb/mmbtu)	Emission Factors CH_4 (lb/mmbtu)	Emission Factors N_2O (lb/mmbtu)	$CO_2(e)$ CO_2 Emission Rate (tpy)	$CO_2(e)$ CH_4 Emission Rate (tpy)	$CO_2(e)$ N_2O Emission Rate (tpy)
C-102	2,370	7504	155792.045	116.887892	0.0022046	0.00022046	9,105.10	3.61	5.32
C-103	2,370	7504	155792.045	116.887892	0.0022046	0.00022046	9,105.10	3.61	5.32
C-104	2,370	7504	155792.045	116.887892	0.0022046	0.00022046	9,105.10	3.61	5.32
M1-G-1	254	472	1051.11	116.887892	0.0022046	0.00022046	61.43	0.02	0.04
Total							27,376.74	10.84	16.01

Diesel Engines

Equipment	HP	Fuel Use (gal/hr)	Heat Content (HHV) (btu/gal)	Fuel Use (HHV) (mmbtu/yr)	Emission Factors CO_2 (lb/mmbtu)	Emission Factors CH_4 (lb/mmbtu)	Emission Factors N_2O (lb/mmbtu)	$CO_2(e)$ CO_2 Emission Rate (tpy)	$CO_2(e)$ CH_4 Emission Rate (tpy)	$CO_2(e)$ N_2O Emission Rate (tpy)
M3-G-2	145	28	137,380	1923	163.052216	0.0066138	0.00132276	156.80	0.13	0.39
M3-G-3	145	28	137,380	1923	163.052216	0.0066138	0.00132276	156.80	0.13	0.39
M4-G-6	145	28	137,380	1923	163.052216	0.0066138	0.00132276	156.80	0.13	0.39
M4-G-7	145	28	137,380	1923	163.052216	0.0066138	0.00132276	156.80	0.13	0.39
M7-G-8	145	28	137,380	1923	163.052216	0.0066138	0.00132276	156.80	0.13	0.39
M7-G-9	145	28	137,380	1923	163.052216	0.0066138	0.00132276	156.80	0.13	0.39
MD1-G-4	53	3	137,380	206	163.052216	0.0066138	0.00132276	16.80	0.01	0.04
MD1-G-5	32	1.8	137,380	124	163.052216	0.0066138	0.00132276	10.08	0.01	0.03
MD2-G-10	53	3	137,380	206	163.052216	0.0066138	0.00132276	16.80	0.01	0.04
MD2-G-11	32	1.8	137,380	124	163.052216	0.0066138	0.00132276	10.08	0.01	0.03
Total								994.57	0.85	2.50

MarkWest Liberty Midstream & Resources L.L.C.
Majorsville Gas Plant

Stabilization Heater
(H-4782)

Source Designation:	
Manufacturer:	Heatec
Year Installed	2014
Fuel Used:	Natural Gas
Higher Heating Value (HHV) (Btu/scf):	1,020
Heat Input (MMBtu/hr)	10.65
Fuel Consumption (mmscf/hr):	1.04E-02
Potential Annual Hours of Operation (hr/yr):	8,760

Criteria and Manufacturer Specific Pollutant Emission Rates

Pollutant	**Emission Factor (lb/MMscf)[a,b]**	**Potential Emissions (lb/hr)[c]**	**(tons/yr)[d]**
NO_x	59.84	0.625	2.737
CO	84	0.877	3.842
SO_2	0.6	0.006	0.0274
PM Total	7.6	0.079	0.3476
PM Condensable	5.7	0.060	0.261
PM_{10} (Filterable)	1.9	0.020	0.087
$PM_{2.5}$ (Filterable)	1.9	0.020	0.087
VOC	5.5	0.057	0.252

MarkWest Liberty Midstream & Resources L.L.C.
Majorsville Gas Plant

Stabilization Heater
(H-4782)

Hazardous Air Pollutant (HAP) Potential Emissions

Pollutant	Emission Factor (lb/MMscf)[a]	Potential Emissions (lb/hr)[c]	Potential Emissions (tons/yr)[d]
HAPs:			
3-Methylchloranthrene	1.80E-06	1.88E-08	8.23E-08
7,12-Dimethylbenz(a)anthracene	1.60E-05	1.67E-07	7.32E-07
Acenaphthene	1.80E-06	1.88E-08	8.23E-08
Acenaphthylene	1.80E-06	1.88E-08	8.23E-08
Anthracene	2.40E-06	2.51E-08	1.10E-07
Benz(a)anthracene	1.80E-06	1.88E-08	8.23E-08
Benzene	2.10E-03	2.19E-05	9.61E-05
Benzo(a)pyrene	1.20E-06	1.25E-08	5.49E-08
Benzo(b)fluoranthene	1.80E-06	1.88E-08	8.23E-08
Benzo(g,h,i)perylene	1.20E-06	1.25E-08	5.49E-08
Benzo(k)fluoranthene	1.80E-06	1.88E-08	8.23E-08
Chrysene	1.80E-06	1.88E-08	8.23E-08
Dibenzo(a,h) anthracene	1.20E-06	1.25E-08	5.49E-08
Dichlorobenzene	1.20E-03	1.25E-05	5.49E-05
Fluoranthene	3.00E-06	3.13E-08	1.37E-07
Fluorene	2.80E-06	2.92E-08	1.28E-07
Formaldehyde	7.50E-02	7.83E-04	3.43E-03
Hexane	1.80E+00	1.88E-02	8.23E-02
Indo(1,2,3-cd)pyrene	1.80E-06	1.88E-08	8.23E-08
Phenanthrene	1.70E-05	1.78E-07	7.78E-07
Pyrene	5.00E-06	5.22E-08	2.29E-07
Toluene	3.40E-03	3.55E-05	1.56E-04
Arsenic	2.00E-04	2.09E-06	9.15E-06
Beryllium	1.20E-05	1.25E-07	5.49E-07
Cadmium	1.10E-03	1.15E-05	5.03E-05
Chromium	1.40E-03	1.46E-05	6.40E-05
Cobalt	8.40E-05	8.77E-07	3.84E-06
Lead	5.00E-04	5.22E-06	2.29E-05
Manganese	3.80E-04	3.97E-06	1.74E-05
Mercury	2.60E-04	2.72E-06	1.19E-05
Nickel	2.10E-03	2.19E-05	9.61E-05
Selenium	2.40E-05	2.51E-07	1.10E-06
Polycyclic Organic Matter:			
Methylnaphthalene (2-)	2.40E-05	2.51E-07	1.10E-06
Naphthalene	6.10E-04	6.37E-06	2.79E-05
Total HAP		**1.97E-02**	**8.64E-02**

[a] Emission factors from AP-42 Section 1.4 "Natural Gas Combustion" Tables 1.4-1, 1.4-2, & 1.4-3

[b] NO_x and CO emission factors from vendor guarantee.

[c] Emission Rate (lb/hr) = Rated Capacity (MMscf/hr) × Emission Factor (lb/MMscf) x (Actual Fuel HHV/1020).

[d] Annual Emissions $(tons/yr)_{Potential}$ = $(lb/hr)_{Emissions}$ × (Maximum Allowable Operating Hours, 8760 hr/yr) × (1 ton/2000 lb).

MarkWest Liberty Midstream & Resources L.L.C.
Majorsville Gas Plant
Pig Receiver

Receiver Diameter (inches)	20
Receiver Length (ft)	30.83
Receiver Volume (ft3)	67.25
Pressure (psig)	960.65
Temperature (°F)	60
Standard Pressure (psia)	14.7
Standard Temperature (°F)	60
Standard Volume (scf)	4462.06
Moles Emitted (moles/event)	11.77
MW	20.44
Event Emissions (lb/event)	240.59
Control Percentage	98%
Annual Events	365

Pollutant	Mass %	Emissions	
		lb/hr	tpy
VOC	17.39%	0.84	0.15
Total HAPs	0.83%	0.04	0.01
Benzene	0.83%	0.04	0.01
Toluene	0.27%	0.01	0.00
Ethylbenzene	0.27%	0.01	0.00
Xylenes	0.09%	0.00	0.00
n-Hexane	0.83%	0.04	0.01
Carbon Dioxide	0.29%	0.71	0.13
Methane	61.82%	2.97	0.54

Williams, Jerry

From: Williams, Jerry
Sent: Monday, January 23, 2017 1:05 PM
To: 'wade.janecek@markwest.com'
Subject: Majorsville Gas Plant Air Permit

Wade,

In regards to the air permit application for Majorsville:

1. Please provide the GHG (CO2e) emissions for the pigging operations.
2. What is heater H-6782? It is not included on Attachment I (Emissions Unit Table) nor the facility wide emissions table (criteria and HAP emissions), but an individual calculation sheet is included for it and you did include it in your facility wide GHG. Please let me know if this exists.

This information is needed for me to continue my review.

Thanks
Jerry

Jerry Williams, P.E.
Engineer
WVDEP – Division of Air Quality
601 57th Street, SE
Charleston, WV 25304
(304) 926-0499 ext. 1223
jerry.williams@wv.gov

dep

Please consider the environment before printing this email.

ID # 051-00127
Reg R13-2815G
Company MARK WEST
Facility MAJORSVILLE Initials JW

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Williams, Jerry

From:	Williams, Jerry
Sent:	Wednesday, January 18, 2017 2:08 PM
To:	'lmeyer@markwest.com'; 'wade.janecek@markwest.com'
Cc:	McKeone, Beverly D
Subject:	WV DAQ NSR Permit Application Complete for MarkWest - Majorsville Gas Plant

RE: Application Status: Complete
MarkWest - Majorsville Gas Plant
Permit Application R13-2818G
Plant ID No. 051-00125

Ms. Meyer,

Your application for a modification permit for a natural gas processing facility was received by this Division on December 8, 2016 and assigned to the writer for review. Upon review of said application, it was determined that the application was incomplete and additional information was requested on December 29, 2016. The requested information was received on January 12, 2017, therefore, the statutory review period commenced on January 12, 2017.

In the case of this application, the agency believes it will take approximately 90 days to make a final permit determination.

This determination of completeness shall not relieve the permit applicant of the requirement to subsequently submit, in a timely manner, any additional or corrected information deemed necessary for a final permit determination.

Should you have any questions, please contact Jerry Williams at (304) 926-0499 ext. 1223 or reply to this email.

Jerry Williams, P.E.
Engineer
WVDEP – Division of Air Quality
601 57th Street, SE
Charleston, WV 25304
(304) 926-0499 ext. 1223
jerry.williams@wv.gov

dep

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Please consider the environment before printing this email.

Williams, Jerry

From: Wade Janecek <Wade.Janecek@markwest.com>
Sent: Thursday, January 12, 2017 6:45 PM
To: Williams, Jerry; Leanne Meyer
Cc: McKeone, Beverly D
Subject: RE: WV DAQ Permit Application Incomplete for MarkWest Liberty Midstream & Resources, LLC - Majorsville Gas Plant (Additional request)
Attachments: H-1782 and H-D2782 Emissions.pdf; H-4782 Emissions.pdf; Legal Ad Affadavit.pdf; Blowdown and Pigging Emissions.pdf; C-102, 103 and 104 Emissions.pdf; Compiled Generator Specification Sheets.pdf; Compiled Heater Specification Sheets.pdf; Emissions Summary.pdf; F-991 Emissions.pdf; FL-1991 Emissions.pdf; GHG Emissions.pdf; H-741 Emissions.pdf; H-781 Emissions.pdf; H-1741 and H-D2741 Emissions.pdf

Mr. Williams,

Below I've included responses to your questions regarding the Majorsville Gas Plant application. You'll find responses to both your 12/29 and 12/30 requests below. In addition I've attached backup documentation as you requested. I've done my best to label and highlight portions of specification sheets for the generators and heaters so it's more clear which sheets belong with which units. If you have any questions about any of the responses below or if I can assist with parsing through those specification sheets please don't hesitate to contact me. You can reach me via email or at 303-542-1212.

ID # 051-00125
Reg R13-2818G
Company MARKWEST
Facility MAJORSVILLE Initials JW

12/29/2016 Request

1. Failure to submit affidavit of publication for Class I legal advertisement.
   a. *Please see the attached notarized affidavit of the legal advertisement.*
2. SIC Code 1311, provided in this permit application is different from the previous permit. The previous permit utilized 1321 which is for natural gas liquid extraction. Please confirm the correct SIC/NAICS code.
   a. *The correct SIC/NAICS code is 1321 for Natural gas liquids.*
3. This permit application indicates there are eight (8) existing emergency generators. However, there are only two (2) emergency generators in your current permit. Please explain the discrepancy.
   a. *During a recent review of the plant it was discovered that several additional emergency generators were required. MarkWest has included the additional units in this application to reflect the as-built configuration at the plant.*
4. The emission point IDs utilized in your current application (specifically Attachment I) do not match what is used in your current permit. Please explain the discrepancy.
   a. *After review of the existing permit and submitted application the only discrepancy MarkWest was able to identify was the change between FL-1991 and FL-3991. As indicated in the cover letter FL-3991 was never installed at the facility and FL-1991 was installed instead. The listed ID was changed to match the as-built configuration at the plant. In addition, the OSBL and ISBL generators were renamed M1-G-1 and M3-G-2 to match plant designations. Please let us know if there are further discrepancies that need to be addressed.*
5. Please provide all pigging and blowdown emissions associated with this facility. This shall include number of annual events and gas released per event (scf/event).
   a. *MarkWest has included a calculation sheet showing anticipated volumes, frequency, and total emissions from blowdowns at the facility.*
6. Attachment L for LDAR only referenced Subpart KKK and OOOO. Is Majorsville VIII subject to OOOOa?
   a. *As discussed during a phone conversation on 12/19/2016 Majorsville VII and DeEthanizer II will be subject to the requirements of Subpart OOOOa.*
7. Please provide clarification on the emergency generator manufacturer's data sheets as to which manufacturer data sheets correlate with the proper emergency generator ID#s.

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a. *Attached are the generator specification sheets which identify which parameters apply to the specific generators at Majorsville.*

8. The permit application provided no emission data for any of the storage tanks. Please provide this information.
   a. *All tanks storing compounds that would result in significant emissions (i.e. produced hydrocarbons) are pressurized, which means that there are no emissions unless a PSV valve discharges during an emergency overpressurization event. MarkWest is not aware of any overpressurization events that have occurred at pressurized storage tanks at this facility. The remaining tanks, storing compounds such as fuel for site equipment, emit negligible amounts of criteria pollutants.*
9. Please provide a source aggregation analysis.
   a. *Per recent EPA guidance aggregation is not appropriate if two facilities are located more than ¼ mile distance from each other. The nearest facility owned and/or operated by MarkWest in West Virginia is the Mobley Gas Plant which is 28.3 miles staightline distance from the Majorsville Plant. The nearest MarkWest facility not in West Virginia is located 10.6 miles away in Pennsylvania.*

12/30/2016 Request

1. Please provide GHG (CO2e) calculations for all emission sources.
   a. *Please find attached CO_2e emission estimates for all sources at the Majorsville Gas Plant.*
2. The annual formaldehyde emissions provided for C-102, 103, 104 appear to have an annual operating limitation of 6,172 hours. Please address.
   a. *MarkWest inadvertently utilized a summary sheet that accounted for downtime during the 2015 calendar year. Emissions estimates have been updated on the summary sheet to reflect the total potential to emit ("PTE") for 8,760 operational hours per year.*
3. The hourly and annual VOC emissions for C-102, 103, 104 are different than what is currently permitted. Please provide emission calculations for all criteria pollutants, HAPs, and GHG for these engines.
   a. *Emissions shown were not inclusive of Formaldehyde. Updated calculation sheets are included and the change is reflected in the included updated emission summary table.*
4. Attachment I lists Emission Unit ID H-2741 twice. It is listed as emission point 9E and 24E. Please address.
   a. *There was an inadvertent overlap in naming convention for the existing regeneration heater designated H-2741 (emission point 9E) and the new DeEthanizer Regneration heater (emission point 24E). The new heater (emission point 24E) should be identified as H-D2741. In addition the DeEthanizer 2 HMO heater (currently listed as H-2782) should be updated to H-D2782 to reflect the most recent naming convention. Both heater names have been updated in the PTE summary table attached and in their respective calculation sheets which are also attached.*
5. Attachment N (Emission Calculations) state in multiple places that NOx, CO, PM, and VOC emissions from heaters (H-1741, 2741, 3741, 4741, 5741, 6741, 7741, 3781, 4781, 7781, 1782, 2782) are from vendor guarantees. Please provide the vendor guarantees for these heaters.
   a. *Spec sheets for the heaters are attached. A note has been made in the top left-hand corner of each specification sheet to identify which heaters that sheet covers.*
6. Please provide emission calculations for heaters H-741, 781, 4782.
   a. *Please find emissions calculations attached.*
7. Please provide emission calculations for flares F-991, 3991.
   a. *Please find emissions calculations attached. Flare 3991 was never installed at the site and FL-1991 was installed in it's place as indicated in the response to question 4 in the first response section.*

Wade Janecek
Senior Environmental Engineer
MarkWest Energy Partners, L.P.
1515 Arapahoe Street | Tower 1 - Suite 1600 | Denver, CO 80202
Direct: (303) 542-1212 Ext. 1512 | Cell: (970) 270-5584
Email: Wade.Janecek@MarkWest.com

From: Williams, Jerry [mailto:Jerry.Williams@wv.gov]
Sent: Friday, December 30, 2016 6:13 AM
To: Wade Janecek; Leanne Meyer
Cc: McKeone, Beverly D
Subject: WV DAQ Permit Application Incomplete for MarkWest Liberty Midstream & Resources, LLC - Majorsville Gas Plant (Additional request)

Upon further review of the permit application, the following items also need addressed in addition to the 12/29/2016 incomplete email in order for the permit application to be deemed complete:

1. Please provide GHG (CO2e) calculations for all emission sources.
2. The annual formaldehyde emissions provided for C-102, 103, 104 appear to have an annual operating limitation of 6,172 hours. Please address.
3. The hourly and annual VOC emissions for C-102, 103, 104 are different than what is currently permitted. Please provide emission calculations for all criteria pollutants, HAPs, and GHG for these engines.
4. Attachment I lists Emission Unit ID H-2741 twice. It is listed as emission point 9E and 24E. Please address.
5. Attachment N (Emission Calculations) state in multiple places that NOx, CO, PM, and VOC emissions from heaters (H-1741, 2741, 3741, 4741, 5741, 6741, 7741, 3781, 4781, 7781, 1782, 2782) are from vendor guarantees. Please provide the vendor guarantees for these heaters.
6. Please provide emission calculations for heaters H-741, 781, 4782.
7. Please provide emission calculations for flares F-991, 3991.

Please address the above deficiencies in writing within fifteen (15) days of the receipt of this email. Application review will not commence until the application has been deemed to be technically complete. Failure to respond to this request in a timely manner may result in the denial of the application.

Should you have any questions, please contact Jerry Williams at (304) 926-0499 ext. 1223 or reply to this email.

From: Williams, Jerry
Sent: Thursday, December 29, 2016 8:05 AM
To: 'lmeyer@markwest.com' <lmeyer@markwest.com>; 'wade.janecek@markwest.com' <wade.janecek@markwest.com>
Cc: McKeone, Beverly D <Beverly.D.Mckeone@wv.gov>
Subject: WV DAQ Permit Application Incomplete for MarkWest Liberty Midstream & Resources, LLC - Majorsville Gas Plant

RE: Application Status: Incomplete
MarkWest Liberty Midstream & Resources, LLC - Majorsville Gas Plant
Permit Application No. R13-2818G
Plant ID No. 051-00125

Ms. Meyer,

Your application for a modification permit for a natural gas processing facility was received by this Division on December 8, 2016 and assigned to the writer for review. Upon initial review of said application, it has been determined that the application as submitted is incomplete based on the following items:

1. Failure to submit affidavit of publication for Class I legal advertisement.
2. SIC Code 1311, provided in this permit application is different from the previous permit. The previous permit utilized 1321 which is for natural gas liquid extraction. Please confirm the correct SIC/NAICS code.

3. This permit application indicates there are eight (8) existing emergency generators. However, there are only two (2) emergency generators in your current permit. Please explain the discrepancy.
4. The emission point IDs utilized in your current application (specifically Attachment I) do not match what is used in your current permit. Please explain the discrepancy.
5. Please provide all pigging and blowdown emissions associated with this facility. This shall include number of annual events and gas released per event (scf/event).
6. Attachment L for LDAR only referenced Subpart KKK and OOOO. Is Majorsville VIII subject to OOOOa?
7. Please provide clarification on the emergency generator manufacturer's data sheets as to which manufacturer data sheets correlate with the proper emergency generator ID#s.
8. The permit application provided no emission data for any of the storage tanks. Please provide this information.
9. Please provide a source aggregation analysis.

Please address the above deficiencies in writing within fifteen (15) days of the receipt of this email. Application review will not commence until the application has been deemed to be technically complete. Failure to respond to this request in a timely manner may result in the denial of the application.

Should you have any questions, please contact Jerry Williams at (304) 926-0499 ext. 1223 or reply to this email.

AIR QUALITY PERMIT NOTICE

Notice of Application

Notice is given that MarkWest Liberty Midstream & Resources LLC has applied to the West Virginia Department of Environmental Protection, Division of Air Quality, for a modification for a natural gas processing plant located on Route 15, Calis Majorsville Road, near Majorsville, in Marshall County, West Virginia. The latitude and longitude coordinates are: N 39.9636 W 80.5206.

The applicant estimates a change in the potential to discharge the following Regulated Air Pollutants will be increases of 16.76 tons per year NOx, 20.66 tons per year CO, 4.59 tons per year PM, and 0.33 tons of HAPs.

Startup of operation is planned to begin on or about December 2017. Written comments will be received by the West Virginia Department of Environmental Protection, Division of Air Quality, 601 57th Street, SE, Charleston, WV 25304, for at least 30 calendar days from the date of publication of this notice.

Any questions regarding this permit application should be directed to the DAQ at (304) 926-0499, extension 1227, during normal business hours.

Dated this the 5th day of December 2016.

By: MarkWest Liberty Midstream & Resources LLC
Leanne Meyer, VP of EH&S
1515 Arapahoe St.
Tower 1, Suite 1600
Denver, CO 80202-2137
Int. Dec. 12, 2016

STATE OF WEST VIRGINIA,
COUNTY OF OHIO.

I Sharon Sullivan *for the publisher of the* **Intelligencer** *newspaper published in the CITY OF WHEELING, STATE OF WEST VIRGINIA, hereby certify that the annexed publication was inserted in said newspaper on the following dates:*

Dec. 12, 2016

Given under my hand this 15th *day of* Dec., 2016

Sworn to and subscribed before me this 22nd *day of* December, 2016 *at* **WHEELING, OHIO COUNTY, WEST VIRGINIA**

Michelle Higgins
Notary Public

of, in and for **OHIO COUNTY, WEST VIRGINIA.**

My Commission expires Aug. 11, 2020

OFFICIAL SEAL
NOTARY PUBLIC
STATE OF WEST VIRGINIA
MICHELLE HIGGINS
Wheeling Newspapers
1500 Main Street
Wheeling, West Virginia 26003
My Commission Expires Aug. 11, 2020

MarkWest Liberty Midstream & Resources L.L.C.
Majorsville Gas Plant

Blowdowns

VOC and HAP Vented Blowdown Emissions

Blowdown Emissions Sources	Number of Units	Vented Gas Volume Per Blowdown Event (scf)	Number of Blowdown Events per year	Total Volume NG Emitted (scf/yr)	Flare Control Efficiency (%)	Potential VOC Emissions (tpy)	Potential HAP Emissions (tpy)
Engines	3	2,200	36	237,600	0	1.03	0.049
Majorsville I&II	2	182,525	4	1,460,200	98	0.13	0.006
Majorsville III & IV	2	250,000	4	2,000,000	98	0.17	0.008
Majorsville V, VI, VII	3	250,000	4	3,000,000	98	0.26	0.012
Deethanizer	1	459,000	4	1,836,000	98	0.16	0.008
Total						**1.75**	**0.084**

Density of natural gas: 0.05 lb/ft^3 @ STP (www.engineeringtoolbox.com)

MarkWest Liberty Midstream and Resources, L.L.C.
Majorsville Gas Plant
Pig Receiver

Receiver Diameter (inches)	20
Receiver Length (ft)	30.83
Receiver Volume (ft3)	67.25
Pressure (psig)	960.65
Temperature (°F)	60
Standard Pressure (psia)	14.7
Standard Temperature (°F)	60
Standard Volume (scf)	4462.06
Moles Emitted (moles/event)	11.77
MW	20.44
Event Emissions (lb/event)	240.59
Control Percentage	98%
Annual Events	365

Pollutant	Mass %	Emissions	
		lb/hr	tpy
VOC	17.39%	0.84	0.15
Total HAPs	0.83%	0.04	0.01
Benzene	0.83%	0.04	0.01
Toluene	0.27%	0.01	0.00
Ethylbenzene	0.27%	0.01	0.00
Xylenes	0.09%	0.00	0.00
n-Hexane	0.83%	0.04	0.01

Power Generation

Exhaust Emission Data Sheet
60DSFAD
60 Hz Diesel Generator Set
EPA Emission: Tier 3

Engine Information:

Model:	Cummins Inc. QSB5-G3 NR3	Bore:	4.21 in. (107 mm)
Type:	4 Cycle, In-line, 4 Cylinder Diesel	Stroke:	4.88 in. (124 mm)
Aspiration:	Turbocharged and CAC	Displacement:	275 cu. in. (4.5 liters)
Compression Ratio:	17.2:1		
Emission Control Device:	Turbocharged with Charge Air Cooled		

	1/4	1/2	3/4	Full	Full
PERFORMANCE DATA	**Standby**	**Standby**	**Standby**	**Standby**	**Prime**
BHP @ 1800 RPM (60 Hz)	26	51	77	103	92
Fuel Consumption (gal/Hr)	1.8	3.0	4.6	5.7	5.3
Exhaust Gas Flow (CFM)	308	433	596	665	646
Exhaust Gas Temperature (°F)	500	624	727	778	765
EXHAUST EMISSION DATA					
HC (Total Unburned Hydrocarbons)	0.24	0.11	0.07	0.04	0.05
NOx (Oxides of Nitrogen as NO2)	2.76	2.15	2.09	2.37	2.20
CO (carbon Monoxide)	2.27	1.18	0.63	0.50	0.56
PM (Particular Matter)	0.28	0.14	0.05	0.06	0.06
SO2 (Sulfur Dioxide)	0.19	0.16	0.15	0.14	0.15
Smoke (Bosch)	0.76	0.60	0.31	0.38	0.37

All values are Grams per HP-Hour

TEST CONDITIONS

Data is representative of steady-state engine speed (± 25 RPM) at designated genset loads. Pressures, temperatures, and emission rates were stabilized.

Fuel Specification:	ASTM D975 No. 2-D diesel fuel with 0.03-0.05% sulfur content (by weight), and 40-48 cetane number.
Fuel Temperature:	99 ± 9 °F (at fuel pump inlet)
Intake Air Temperature:	77 ± 9 °F
Barometric Pressure:	29.6 ± 1 in. Hg
Humidity:	NOx measurement corrected to 75 grains H2O/lb dry air
Reference Standard:	ISO 8178

The NOx, HC, CO and PM emission data tabulated here were taken from a single engine under the test conditions shown above. Data for the other components are estimated. These data are subjected to instrumentation and engine-to-engine variability. Field emission test data are not guaranteed to these levels. Actual field test results may vary due to test site conditions, installation, fuel specification, test procedures and instrumentation. Engine operation with excessive air intake or exhaust restriction beyond published maximum limits, or with improper maintenance, may results in elevated emission levels.

ISBL

Model: DSFAD
Frequency: 60
Fuel type: Diesel
KW rating: 60 standby
55 prime
Emissions level: EPA NSPS Stationary Emergency Tier 3

> Generator set data sheet

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Exhaust emission data sheet:	**EDS-1089**
Exhaust emission compliance sheet:	**EPA-1123**
Sound performance data sheet:	**MSP-1069**
Cooling performance data sheet:	**MCP-176**
Prototype test summary data sheet:	**PTS-275**
Standard set-mounted radiator cooling outline:	**0500-4552**
Optional set-mounted radiator cooling outline:	
Optional heat exchanger cooling outline:	
Optional remote radiator cooling outline:	

Fuel consumption	**Standby kW (kVA)**				**Prime kW (kVA)**				**Continuous kW (kVA)**
Ratings	60 (75)				55 (69)				
Load	**1/4**	**1/2**	**3/4**	**Full**	**1/4**	**1/2**	**3/4**	**Full**	**Full**
US gph	1.8	3.0	4.6	5.7	1.7	2.7	4.1	5.3	
L/hr	6.8	11.4	17.6	21.4	6.4	10.3	15.7	20.2	

Engine	**Standby rating**	**Prime rating**	**Continuous rating**
Engine manufacturer	Cummins Inc.		
Engine model	QSB5-G3 NR3		
Configuration	Cast iron, in-line, 4 cylinder		
Aspiration	Turbocharged and air-to-air aftercooled		
Gross engine power output, kWm (bhp)	108 (145)	94 (126)	
BMEP at set rated load, kPa (psi)	1133 (164)	1050 (152)	
Bore, mm (in.)	107 (4.21)		
Stroke, mm (in.)	124 (4.88)		
Rated speed, rpm	1800		
Piston speed, m/s (ft/min)	7.4 (1464)		
Compression ratio	17.3:1		
Lube oil capacity, L (qt)	12.1 (12.8)		
Overspeed limit, rpm	2100 ±50		
Regenerative power, kW	13		

Fuel flow		
Maximum fuel flow with C180, L/hr (US gph)	106 (28)	
Maximum fuel flow with C174, L/hr (US gph)		
Maximum fuel inlet restriction with clean filter, mm Hg (in. Hg)	127 (5)	
Maximum return restriction, mm Hg (in. Hg)	152 (6)	

Air	Standby rating	Prime rating	Continuous rating
Combustion air, m^3/min (scfm)	8.0 (284)	7.8 (275)	
Maximum air cleaner restriction, kPa (in. H_2O)	3.7 (15)		
Alternator cooling air, m^3/min (cfm)	37.0 (1308)		

Exhaust			
Exhaust flow at set rated load, m^3/min (cfm)	18.8 (665)	18.6 (655)	
Exhaust temperature, °C (°F)	415 (778)	411 (772)	
Maximum back pressure, kPa (in. H_2O)	10 (40)		

Standard set-mounted radiator cooling			
Ambient design, °C (°F)	55 (131)		
Fan load, kW_m (HP)	9.3 (12.5)		
Coolant capacity (with radiator), L (US Gal.)	17 (4.5)		
Cooling system air flow, m^3/min (scfm)	189 (6675)		
Total heat rejection, MJ/min (Btu/min)	3.18 (3010)	3.06 (2900)	
Maximum cooling air flow static restriction, kPa (in. H_2O)	0.12 (0.5)		

Optional set-mounted radiator cooling			
Ambient design, °C (°F)			
Fan load, kW_m (HP)			
Coolant capacity (with radiator), L (US Gal.)			
Cooling system air flow, m^3/min (scfm)			
Total heat rejection, MJ/min (Btu/min)			
Maximum cooling air flow static restriction, kPa (in. H_2O)			

Optional heat exchanger cooling			
Set coolant capacity, L (US Gal.)			
Heat rejected, jacket water circuit, MJ/min (Btu/min)			
Heat rejected, aftercooler circuit, MJ/min (Btu/min)			
Heat rejected, fuel circuit, MJ/min (Btu/min)			
Total heat radiated to room, MJ/min (Btu/min)			
Maximum raw water pressure, jacket water circuit, kPa (psi)			
Maximum raw water pressure, aftercooler circuit, kPa (psi)			
Maximum raw water pressure, fuel circuit, kPa (psi)			
Maximum raw water flow, jacket water circuit, L/min (US Gal/min)			
Maximum raw water flow, aftercooler circuit, L/min (US Gal/min)			
Maximum raw water flow, fuel circuit, L/min (US Gal/min)			
Minimum raw water flow at 27 °C (80 °F) inlet temp, jacket water circuit, L/min (US Gal/min)			
Minimum raw water flow at 27 °C (80 °F) inlet temp, aftercooler circuit, L/min (US Gal/min)			
Minimum raw water flow at 27 °C (80 °F) inlet temp, fuel circuit, L/min (US Gal/min)			
Raw water delta P at min flow, jacket water circuit, kPa (psi)			
Raw water delta P at min flow, aftercooler circuit, kPa (psi)			
Raw water delta P at min flow, fuel circuit, kPa (psi)			
Maximum jacket water outlet temp, °C (°F)			
Maximum aftercooler inlet temp, °C (°F)			
Maximum aftercooler inlet temp at 25 °C (77 °F) ambient, °C (°F)			

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D-3369b (11/11)

Power Generation

Optional remote radiator cooling[1]	Standby rating	Prime rating	Continuous rating
Set coolant capacity, L (US gal)			
Max flow rate at max friction head, jacket water circuit, L/min (US gal/min)			
Max flow rate at max friction head, aftercooler circuit, L/min (US gal/min)			
Heat rejected, jacket water circuit, MJ/min (Btu/min)			
Heat rejected, aftercooler circuit, MJ/min (Btu/min)			
Heat rejected, fuel circuit, MJ/min (Btu/min)			
Total heat radiated to room, MJ/min (Btu/min)			
Maximum friction head, jacket water circuit, kPa (psi)			
Maximum friction head, aftercooler circuit, kPa (psi)			
Maximum static head, jacket water circuit, m (ft)			
Maximum static head, aftercooler circuit, m (ft)			
Maximum jacket water outlet temp, °C (°F)			
Maximum aftercooler inlet temp at 25 °C (77 °F) ambient, °C (°F)			
Maximum aftercooler inlet temp, °C (°F)			
Maximum fuel flow, L/hr (US gph)			
Maximum fuel return line restriction, kPa (in Hg)			

Weights[2]

Unit dry weight kgs (lbs.)	1120 (2470)
Unit wet weight kgs (lbs.)	1140 (2520)

Notes:

[1] For non-standard remote installations contact your local Cummins Power Generation representative.

[2] Weights represent a set with standard features. See outline drawing for weights of other configurations.

Derating factors

Standby	Engine power available up to 3050 m (10,000 ft) at ambient temperatures up to 55 °C (131 °F). Consult your Cummins Power Generation distributor for temperature and ambient requirements outside these parameters.
Prime	Engine power available up to 3050 m (10,000 ft) at ambient temperatures up to 55 °C (131 °F). Consult your Cummins Power Generation distributor for temperature and ambient requirements outside these parameters.
Continuous	

Ratings definitions

Standby:	Prime (unlimited running time):	Base load (continuous):
Applicable for supplying emergency power for the duration of normal power interruption. No sustained overload capability is available for this rating (equivalent to fuel stop power in accordance with ISO3046, AS2789, DIN6271 and BS5514). Nominally rated.	Applicable for supplying power in lieu of commercially purchased power. Prime power is the maximum power available at a variable load for an unlimited number of hours. A 10% overload capability is available for limited time (equivalent to prime power in accordance with ISO8528 and overload power in accordance with ISO3046, AS2789, DIN6271 and BS5514). This rating is not applicable to all generator set models.	Applicable for supplying power continuously to a constant load up to the full output rating for unlimited hours. No sustained overload capability is available for this rating. Consult authorized distributor for rating (equivalent to continuous power in accordance with ISO8528, ISO3046, AS2789, DIN6271 and BS5514). This rating is not applicable to all generator set models.

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D-3369b (11/11)

Power Generation

Alternator data

Three phase table[1]		105° C	105° C	105° C	105° C	125° C	125° C	125° C	125° C	150° C	150° C	150° C
Feature code		B418	B415	B268	B304	B417	B267	B414	B303	B416	B413	B419
Alternator data sheet number		204	204	207	204	204	205	204	203	204	204	203
Voltage ranges		110/190 thru 120/208 220/380 thru 240/416	120/208 thru 139/240 240/416 thru 277/480	120/208 thru 139/240 240/416 thru 277/480	347/600	110/190 thru 120/208 220/380 thru 240/416	120/208 thru 139/240 240/416 thru 277/480	120/208 thru 139/240 240/416 thru 277/480	347/600	110/190 thru 120/208 220/380 thru 240/416	120/208 thru 139/240 240/416 thru 277/480	347/600
Surge kW		66	66	67	65	66	66	66	65	66	66	65
Motor starting kVA (at 90% sustained voltage)	Shunt	231	231	360	231	231	260	231	188	231	231	188
	PMG	272	272	423	272	272	306	272	221	272	272	221
Full load current - Amps at standby rating	120/208 208	127/220 197	139/240 180	220/380 114	240/416 104	277/480 90	347/600 72					

Single phase table		105° C	105° C	105° C	105° C	125° C	125° C	125° C	125° C			
Feature code		B418	B415	B274	B268	B417	B414	B273	B267			
Alternator data sheet Number		204	204	205	207	204	204	204	205			
Voltage ranges		120/240[2]	120/240[2]	120/240[3]	120/240[3]	120/240[2]	120/240[2]	120/240[3]	120/240[3]			
Surge kW		61	64	66	65	60	63	65	64			
Motor starting kVA (at 90% sustained voltage)	Shunt	130	130	155	215	130	130	130	155			
	PMG	153	153	183	250	153	153	153	183			
Full load current - Amps at standby rating	120/240[2] 167	120/240[3] 250										

[1] Single phase power can be taken from a three phase generator set at up to 2/3 set rated 3-phase kW at 1.0 power factor. Also see Note 3 below.
[2] The broad range alternators can supply single phase output up to 2/3 set rated 3-phase kW at 1.0 power factor.
[3] The extended stack (full single phase output) and 4 lead alternators can supply single phase output up to full set rated 3-phase kW at 1.0 power factor.

Formulas for calculating full load currents:

Three phase output

$$\frac{kW \times 1000}{Voltage \times 1.73 \times 0.8}$$

Single phase output

$$\frac{kW \times SinglePhaseFactor \times 1000}{Voltage}$$

Cummins Power Generation
1400 73rd Avenue N.E.
Minneapolis, MN 55432 USA
Phone: 763 574 5000
USA toll-free: 877 769 7669
Fax: 763 574 5298

Warning: Back feed to a utility system can cause electrocution and/or property damage. Do not connect to any building's electrical system except through an approved device or after building main switch is open.

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D-3369b (11/11)

Power Generation

SPECIFICATIONS

GENERATOR

Type ..... Synchronous
Rotor Insulation ..... Class F or H (see Data Label)
Stator Insulation ..... Class H
Total Harmonic Distortion ..... < 3.5%
Telephone Interference Factor (TIF) ..... < 50
Alternator Output Leads 1-phase 4-wire
Alternator Output Leads 3-phase 6-wire
Bearings ..... Sealed Ball
Coupling ..... Flexible Disc
Load Capacity (Standby Rating) 150kW*

* NOTE: Generator rating and performance in accordance with ISO8528-5, BS5514, SAE J1349, ISO3046 and DIN 6271 Standards. KW rating is based on LPG fuel and may derate with natural gas.

Excitation System ..... Brushless

Generator Output Voltage/kW - 60 Hz	kW	Amp	CB Size
120/240V, 1-phase, 1.0 pf	150	625	700
120/208V, 3-phase, 0.8 pf	150	520	600
277/480V, 3-phase, 0.8 pf	150	226	250

Generator Locked Rotor KVA Available @ Voltage Dip of 35%
Single-phase or 208 3-phase ..... 320 KVA
480V, 3-phase ..... 350 KVA

ENGINE

Make ..... Generac
Model ..... V-type
Cylinders and Arrangement 10
Displacement ..... 6.8 Liter
Bore ..... 3.55 in.
Stroke ..... 4.17 in.
Compression Ratio 9-to-1
Air Intake System ..... Naturally Aspirated
Valve Seats ..... Hardened
Lifter Type ..... Hydraulic

Engine Parameters
Rated Synchronous RPM ..... 60 Hz, 3600
HP at rated kW ..... 60 Hz, 254

Exhaust System
Exhaust Flow at Rated Output 60 Hz ..... 1535 cfm
Exhaust Temperature at Rated Output ..... 1100° F

Combustion Air Requirements (Natural Gas)
Flow at rated power, 60 Hz ..... 410 cfm

Governor
Type ..... Electronic
Frequency Regulation ..... Isochronous
Steady State Regulation ..... ± 1/4%
Adjustments:
Speed ..... Selectable

Engine Lubrication System
Type of Oil Pump ..... Gear
Oil Filter ..... Full Flow, Cartridge
Crankcase Oil Capacity ..... 5 U.S. qts.

COOLING SYSTEM

Type ..... Closed
Water Pump ..... Belt Driven
Fan Speed 2200
Fan Diameter ..... 26 inches
Fan Mode ..... Puller
Air Flow (inlet air including alternator and combustion air) ..... 7800 ft3/min.
Coolant Capacity ..... (4.5 U.S. gal.)
Heat Rejection to Coolant ..... 568,000 Btu/h
Maximum Operating Air Temp. on Radiator ..... 60° C (150° F)
Maximum Ambient Temperature ..... 50° C (140° F)

FUEL SYSTEM

Type of Fuel ..... Propane or Natural Gas*
Carburetor ..... Down Draft
Secondary Fuel Regulator ..... Standard
Fuel Shut-off Solenoid ..... Standard
Operating Fuel Pressure ..... 11 in. - 14 in. Water Column

Fuel Consumption - ft³/hr (Natural Gas/LPV)

Exercise Cycle	*25% Load*	*50% Load*	*75% Load*	*100% Load*
155/63	556/224	1070/431	1491/600	2061/830

* Engine is not field convertible between natural gas and propane. Jet size and ignition timing are factory set for the specific fuel.

ELECTRICAL SYSTEM

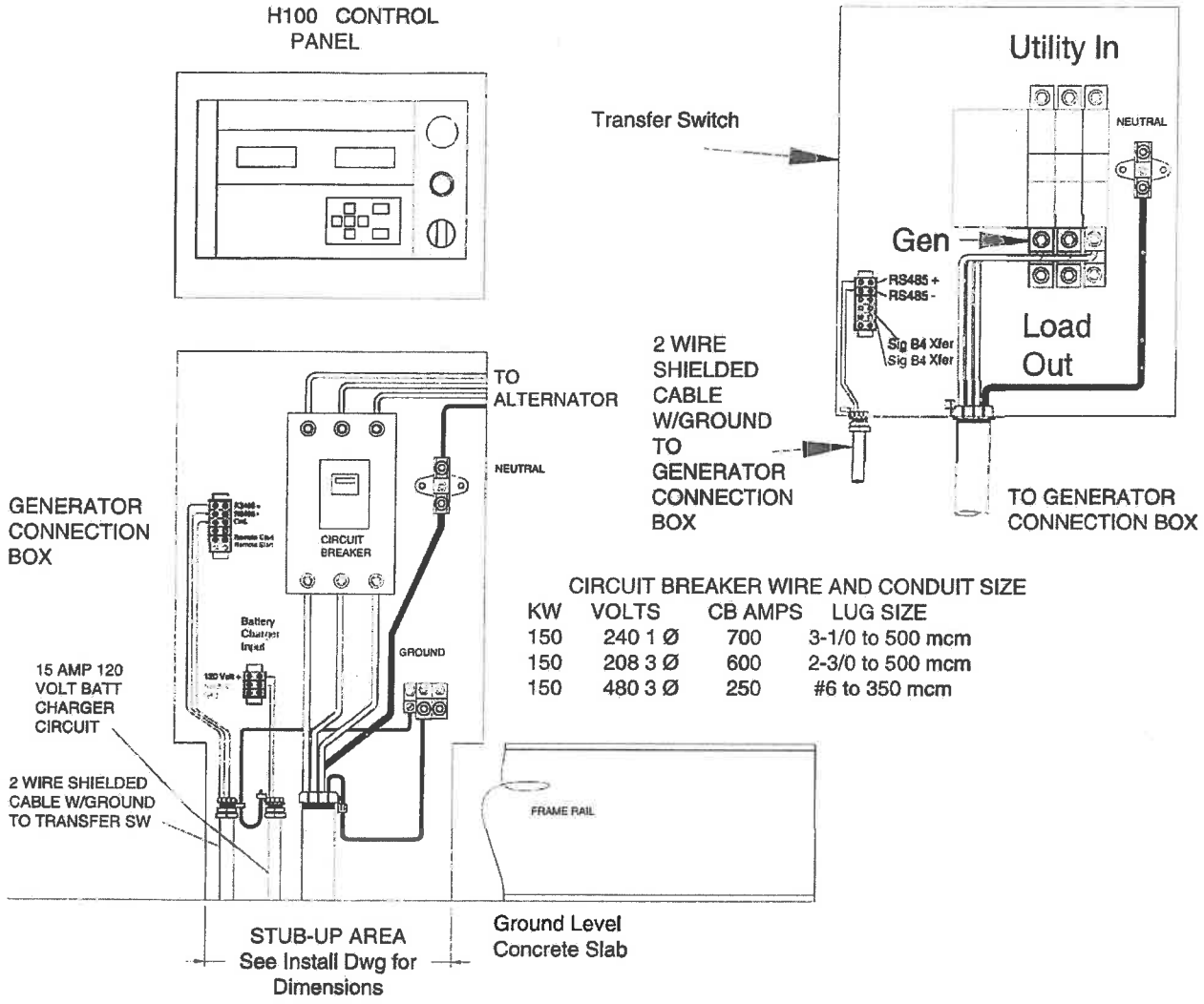
Battery Charge Alternator ..... 12V, 30 Amp
Static Battery Charger ..... 12V, 2 Amp
Recommended Battery 24F 525CCA
System Voltage ..... 12 Volts

Voltage Regulator
Type ..... Full Digital
Sensing 3-phase
Regulation ..... ± 1/4%
Features ..... Built into H-100 Control Panel
V/F Adjustable, Adjustable Voltage and Gain

Power Adjustment for Ambient Conditions
Temperature Deration
3% for every 10° C above °C 25
1.65% for every 10° above °F 77
Altitude Deration
1% for every 100 m above m 183
3% for every 1000 ft. above ft. 600

Controller ..... H-panel

Figure 1 — Interconnections



CIRCUIT BREAKER WIRE AND CONDUIT SIZE

KW	VOLTS	CB AMPS	LUG SIZE
150	240 1 Ø	700	3-1/0 to 500 mcm
150	208 3 Ø	600	2-3/0 to 500 mcm
150	480 3 Ø	250	#6 to 350 mcm

◆ COLD WEATHER KIT

For cold climates, optional cold weather kit (part number 0F6148A) is recommended. The kit includes:

- Battery Warmer
- 4" Junction Box with hardware
- Thermostat; 20 deg "ON", 40 deg "OFF"
- 6 qt. pack 5W-30 synthetic oil (engine)

5.4L & 6.8L IGNITION DESCRIPTION

This single-fire Ignition is intended to operate with a 10-cylinder, 6.8L engine and an 8-cylinder, 5.4L engine.

The 6.8L engine uses a 40-1 crank sensor, a mag-pickup CAM sensor and individual coil-on-plug coils for each spark-plug.

The 5.4L engine uses a 36-1 crank sensor, a mag-pick-up CAM sensor and individual coil-on-plug coils for each spark-plug.

With a single-fire ignition, each high-voltage coil output is connected to one spark plug resulting in that spark plug being fired only during the compression cycle.

Engine Timing versus Engine Speed for the 6.8L engine is:

RPM	NG/LP Engine Timing (BTDC)
1800 rpm	22 degrees
3600 rpm	24 degrees

Engine Timing versus Engine Speed for the 5.4L engine is:

RPM	NG/LP Engine Timing (BTDC)
1800 rpm	26 degrees
3600 rpm	26 degrees

◆ IGNITION POWER-UP INPUT ("56 LINE INPUT")

When battery voltage is applied to this input the ignition will power-up. For the ignition to power itself down, battery voltage must be removed from this input.

◆ IGNITION ENABLE ("14 LINE INPUT")

This input must be connected to the +12V battery for the ignition to turn-on the coils. If this input is connected to battery ground the ignition will stop firing the coils and will power down within approximately 2 seconds. In the event that an ignition fault has occurred, however, the ignition will wait 60 seconds before powering down. This allows time to view the diagnostic LED located on the ignition board.

NOTE:

The ignition cover does not need to be removed to see the LED.

◆ IGNITION SHUTDOWN ON LOSS OF CRANK OR CAM SIGNALS

The ignition will stop firing the coils immediately following the loss of the crank signal. The ignition will stop firing the coils after approx. 3 seconds following the loss of the cam signal.

◆ DIAGNOSTIC BLINK PATTERNS (RED LED LOCATED ON THE IGNITION CONTROL BOARD)

During normal ignition operation the RED LED flashes at a 0.5 sec ON and a 0.5 sec OFF rate. This is considered one (1) blink.

LED Fault Code with Priority as shown:

1. No Crank Signal: LED blinks 2 times, is OFF for 3.0 seconds and then repeats
2. No CAM Signal: LED blinks 3 times, is OFF for 3.0 seconds and then repeats

Only one fault is displayed at a time. If multiple faults exist then the highest priority fault must be resolved prior to a lower priority fault being displayed. In the event that an ignition fault has occurred the ignition will wait 60 seconds before powering down.

NOTE:

The ignition cover does not need to be removed to see the LED.

Flip-hood Design Standard

Model MMG 35 (shown)
Also Available: MMG 25, MMG 45

Model MMG 130

Mobile Generator Specifications

Model	MMG 25	MMG 35	MMG 45	MMG 75	MMG 100 IT4	MMG 100 T3
Output						
3 Phase - Standby (kW/kVA)	20 / 25	29 / 38	35 / 44	69 / 86	86 / 107	86 / 107
Amps (480/208 V)	30 / 69	43 / 100	53 / 122	103 / 239	129 / 297	129 / 297
3 Phase - Prime (kW/kVA)	18 / 23	26 / 33	33 / 41	62 / 77	78 / 98	78 / 98
Amps (480/208 V)	28 / 64	40 / 92	49 / 114	93 / 214	118 / 272	118 / 272
1 Phase - Standby (kW/kVA)	16 / 16	26 / 26	33 / 33	60 / 60	75 / 75	75 / 75
Amps (240V)	67	108	138	250	313	313
1 Phase - Prime (kW/kVA)	15 / 15	25 / 25	30 / 30	56 / 56	71 / 71	71 / 71
Amps	63	104	125	233	296	296
AC Voltage 1-phase	120, 139, 208, 220, 240, 277		120, 139, 208, 220, 240, 277		120, 139, 208, 220, 240, 277	
AC Voltage 3-phase	208, 220, 440, 480		208, 220, 440, 480		208, 220, 440, 480	
Frequency Hz	60	60	60	60	60	60
Power Factor	1 (1Ø), 0.8 (3Ø)	1 (1Ø), 0.8 (3Ø)	1 (1Ø), 0.8 (3Ø)	1 (1Ø), 0.8 (3Ø)	1.0 (1Ø), .8 (3Ø)	1.0 (1Ø), .8 (3 Ø)
Generator (Brand/Type/Insulation)	Marathon/Brushless/H		Marathon/Brushless/H		Marathon/Brushless/H	
Sound (dB(A) @ 23 Feet @ prime)	66	68	68	68	68	68
CSA Listed	Yes	Yes	Yes	Yes	Pending	Yes
Size and Weight						
Skid Mounted (l x w x h) in	95 x 35 x 52	95 x 35 x 52	95 x 35 x 52	101 x 40 x 68	101 x 40 x 68	96 x 38 x 62
Dry Weight lb (kg)	2048 (929)	2020 (916)	2329 (1056)	3530 (1600)	3790 (1719)	3402 (1543)
Operating Weight lb (kg)	2517 (1142)	2475 (1123)	3082 (1398)	4700 (2131)	4740 (2150)	4361 (1978)
Trailer Mounted (l x w x h) (in)	150 x 57 x 67	150 x 57 x 67	150 x 57 x 67	166 x 62 x 84	166 x 62 x 84	158 x 60 x 84
Dry Weight lb (kg)	2289 (1038)	2540 (1152)	2853 (1294)	4240 (1923)	4480 (2032)	4104 (1860)
Operating Weight lb (kg)	2758 (1251)	2990 (1356)	3606 (1636)	5410 (2454)	5440 (2468)	5062 (2296)
Engine	Interim Tier 4	Interim Tier 4	Interim Tier 4	Interim Tier 4	Interim Tier 4	Tier 3 Flex
Brand	Isuzu	John Deere	Kubota	John Deere	John Deere	John Deere
Model #	4LE1NYGV	PE4024TF281	V3600-T-E3BG	PE4045HFG92	PE4045HFG92	PE4045HF285
Aspiration	Natural	Turbo	Turbo	Turbo	Turbo	Turbo
HP (prime @ 1800rpm) (kW)	32 (24)	43 (32)	53 (39)	97 (72)	121 (90)	122 (91)
Displacement in³ (L)	134 (2.2)	149 (2.4)	221 (3.6)	274 (4.5)	275 (4.5)	274 (4.5)
Cylinders	4	4	4	4	4	4
Speed (rpm)	1800	1800	1800	1800	1800	1800
Fuel Consumed prime gph (Lph)	1.8 (6.8)	2.6 (9.8)	3.0 (11.4)	4.78 (18.1)	6.2 (23.5)	6.2 (23.5)
Battery (12 volt)	1 - 12V/720 CCA	1 - 12V/720 CCA	1 - 12V/720 CCA	1 - 12V/720 CCA	1 - 12V/720 CCA	1 - 12V/720 CCA
Capacities						
Fuel Tank gal (L)	106 (401)	106 (401)	106 (401)	165 (625)	165 (625)	147 (556)
Approximate Run Time hrs	45.4	36.9	31	31	24.4	22
AC Distribution						
Main Breaker	90	125	200	300	400	400
Voltage Selection	3 Position Switch (Lockable)		3 Position Switch (Lockable)		3 Position Switch (Lockable)	
Voltage Regulation	+/- 1%	+/-1%	+/- 1%	+/- 1%	+/- 1%	+/- 1%
120V - 20 amp GFCI Duplex	2	2	2	2	2	2
240V - 30 amp Twist Lock	NA	NA	NA	NA	NA	NA
240V - 50 amp Twist Lock	2	2	2	3	3	3
Trailer						
# of Axles & Capacity lbs (kg)	1 - 3500 (1588)	1 - 3500 (1588)	1 - 5000 (2268)	1 - 6000 (2722)	1 - 6000 (2722)	1 - 6000 (2722)
Tire Size (in)	15	15	15	15	15	15
Brakes	None	Surge	Surge	Surge	Surge	Surge
Hitch – Standard	2" Ball	2" Ball	2" Ball	3" Ring	3" Ring	3" Ring

Specifications or designs are subject to change without notice.

Specifications for the four door enclosure design may vary from those listed above. Call factory for details

Flip-hood Design Standard

Model MMG 35 (shown)
Also Available: MMG 25, MMG 45

Model MMG 130

Mobile Generator Specifications

Model	MMG 25	MMG 35	MMG 45	MMG 75	MMG 100 IT4	MMG 100 T3
Output						
3 Phase - Standby (kW/kVA)	20 / 25	29 / 38	35 / 44	69 / 86	86 / 107	86 / 107
Amps (480/208 V)	30 / 69	43 / 100	53 / 122	103 / 239	129 / 297	129 / 297
3 Phase - Prime (kW/kVA)	18 / 23	26 / 33	33 / 41	62 / 77	78 / 98	78 / 98
Amps (480/208 V)	28 / 64	40 / 92	49 / 114	93 / 214	118 / 272	118 / 272
1 Phase - Standby (kW/kVA)	16 / 16	26 / 26	33 / 33	60 / 60	75 / 75	75 / 75
Amps (240V)	67	108	138	250	313	313
1 Phase - Prime (kW/kVA)	15 / 15	25 / 25	30 / 30	56 / 56	71 / 71	71 / 71
Amps	63	104	125	233	296	296
AC Voltage 1-phase	120, 139, 208, 220, 240, 277		120, 139, 208, 220, 240, 277		120, 139, 208, 220, 240, 277	
AC Voltage 3-phase	208, 220, 440, 480		208, 220, 440, 480		208, 220, 440, 480	
Frequency Hz	60	60	60	60	60	60
Power Factor	1 (1Ø), 0.8 (3Ø)	1 (1Ø), 0.8 (3Ø)	1 (1Ø), 0.8 (3Ø)	1 (1Ø), 0.8 (3Ø)	1.0 (1Ø), .8 (3Ø)	1.0 (1Ø), .8 (3 Ø)
Generator (Brand/Type/Insulation)	Marathon/Brushless/H		Marathon/Brushless/H		Marathon/Brushless/H	
Sound (dB(A) @ 23 Feet @ prime)	66	68	68	68	68	68
CSA Listed	Yes	Yes	Yes	Yes	Pending	Yes
Size and Weight						
Skid Mounted (l x w x h) in	95 x 35 x 52	95 x 35 x 52	95 x 35 x 52	101 x 40 x 38	101 x 40 x 66	96 x 38 x 62
Dry Weight lb (kg)	2048 (929)	2020 (916)	2329 (1056)	3530 (1600)	3790 (1719)	3402 (1543)
Operating Weight lb (kg)	2517 (1142)	2475 (1123)	3082 (1398)	4700 (2131)	4740 (2150)	4361 (1978)
Trailer Mounted (l x w x h) (in)	150 x 57 x 67	150 x 57 x 67	150 x 57 x 67	166 x 62 x 84	166 x 62 x 84	158 x 60 x 84
Dry Weight lb (kg)	2289 (1038)	2540 (1152)	2853 (1294)	4240 (1923)	4480 (2032)	4104 (1860)
Operating Weight lb (kg)	2758 (1251)	2990 (1356)	3606 (1636)	5410 (2454)	5440 (2468)	5062 (2296)
Engine	Interim Tier 4	Interim Tier 4	Interim Tier 4	Interim Tier 4	Interim Tier 4	Tier 3 Flex
Brand	Isuzu	John Deere	Kubota	John Deere	John Deere	John Deere
Model #	4LE1NYGV	PE4024TF281	V3600-T-E3BG	PE4045HFG92	PE4045HFG92	PE4045HF285
Aspiration	Natural	Turbo	Turbo	Turbo	Turbo	Turbo
HP (prime @ 1800rpm) (kW)	32 (24)	43 (32)	53 (39)	97 (72)	121 (90)	122 (91)
Displacement in³ (L)	134 (2.2)	149 (2.4)	221 (3.6)	274 (4.5)	275 (4.5)	274 (4.5)
Cylinders	4	4	4	4	4	4
Speed (rpm)	1800	1800	1800	1800	1800	1800
Fuel Consumed prime gph (Lph)	1.8 (6.8)	2.6 (9.8)	3.0 (11.4)	4.78 (18.1)	6.2 (23.5)	6.2 (23.5)
Battery (12 volt)	1 - 12V/720 CCA	1 - 12V/720 CCA	1 - 12V/720 CCA	1 - 12V/720 CCA	1 - 12V/720 CCA	1 - 12V/720 CCA
Capacities						
Fuel Tank gal (L)	106 (401)	106 (401)	106 (401)	165 (625)	165 (625)	147 (556)
Approximate Run Time hrs	45.4	36.9	31	31	24.4	22
AC Distribution						
Main Breaker	90	125	200	300	400	400
Voltage Selection	3 Position Switch (Lockable)		3 Position Switch (Lockable)		3 Position Switch (Lockable)	
Voltage Regulation	+/- 1%	+/-1%	+/- 1%	+/- 1%	+/- 1%	+/- 1%
120V - 20 amp GFCI Duplex	2	2	2	2	2	2
240V - 30 amp Twist Lock	NA	NA	NA	NA	NA	NA
240V - 50 amp Twist Lock	2	2	2	3	3	3
Trailer						
# of Axles & Capacity lbs (kg)	1 - 3500 (1588)	1 - 3500 (1588)	1 - 5000 (2268)	1 - 6000 (2722)	1 - 6000 (2722)	1 - 6000 (2722)
Tire Size (in)	15	15	15	15	15	15
Brakes	None	Surge	Surge	Surge	Surge	Surge
Hitch - Standard	2" Ball	2" Ball	2" Ball	3" Ring	3" Ring	3" Ring

Specifications or designs are subject to change without notice.

Specifications for the four door enclosure design may vary from those listed above. Call factory for details

MarkWest Liberty Midstream & Resources L.L.C.
Majorsville Gas Plant

Hot Oil Heater
(H-1782, H-D2782)

Source Designation:	
Manufacturer:	Optimized Process Furnaces
Year Installed	TBD
Fuel Used:	Natural Gas
Higher Heating Value (HHV) (Btu/scf):	1,020
Heat Input (MMBtu/hr)	119.20
Fuel Consumption (mmscf/hr):	1.17E-01
Potential Annual Hours of Operation (hr/yr):	8,760

Criteria and Manufacturer Specific Pollutant Emission Rates

Pollutant	**Emission Factor (lb/MMscf)[a,b]**	**Potential Emissions (lb/hr)[c]**	**Potential Emissions (tons/yr)[d]**
NO_x	30.60	3.576	15.663
CO	40.8	4.768	20.884
SO_2	0.6	0.070	0.3071
PM Total	7.6	0.888	3.8901
PM Condensable	5.7	0.666	2.918
PM_{10} (Filterable)	1.9	0.222	0.973
$PM_{2.5}$ (Filterable)	1.9	0.222	0.973
VOC	5.5	0.643	2.815

MarkWest Liberty Midstream & Resources L.L.C.
Majorsville Gas Plant

Hot Oil Heater
(H-1782, H-D2782)

Hazardous Air Pollutant (HAP) Potential Emissions

Pollutant	Emission Factor (lb/MMscf)[a]	Potential Emissions (lb/hr)[c]	Potential Emissions (tons/yr)[d]
HAPs:			
3-Methylchloranthrene	1.80E-06	2.10E-07	9.21E-07
7,12-Dimethylbenz(a)anthracene	1.60E-05	1.87E-06	8.19E-06
Acenaphthene	1.80E-06	2.10E-07	9.21E-07
Acenaphthylene	1.80E-06	2.10E-07	9.21E-07
Anthracene	2.40E-06	2.80E-07	1.23E-06
Benz(a)anthracene	1.80E-06	2.10E-07	9.21E-07
Benzene	2.10E-03	2.45E-04	1.07E-03
Benzo(a)pyrene	1.20E-06	1.40E-07	6.14E-07
Benzo(b)fluoranthene	1.80E-06	2.10E-07	9.21E-07
Benzo(g,h,i)perylene	1.20E-06	1.40E-07	6.14E-07
Benzo(k)fluoranthene	1.80E-06	2.10E-07	9.21E-07
Chrysene	1.80E-06	2.10E-07	9.21E-07
Dibenzo(a,h) anthracene	1.20E-06	1.40E-07	6.14E-07
Dichlorobenzene	1.20E-03	1.40E-04	6.14E-04
Fluoranthene	3.00E-06	3.51E-07	1.54E-06
Fluorene	2.80E-06	3.27E-07	1.43E-06
Formaldehyde	7.50E-02	8.76E-03	3.84E-02
Hexane	1.80E+00	2.10E-01	9.21E-01
Indo(1,2,3-cd)pyrene	1.80E-06	2.10E-07	9.21E-07
Phenanthrene	1.70E-05	1.99E-06	8.70E-06
Pyrene	5.00E-06	5.84E-07	2.56E-06
Toluene	3.40E-03	3.97E-04	1.74E-03
Arsenic	2.00E-04	2.34E-05	1.02E-04
Beryllium	1.20E-05	1.40E-06	6.14E-06
Cadmium	1.10E-03	1.29E-04	5.63E-04
Chromium	1.40E-03	1.64E-04	7.17E-04
Cobalt	8.40E-05	9.82E-06	4.30E-05
Lead	5.00E-04	5.84E-05	2.56E-04
Manganese	3.80E-04	4.44E-05	1.95E-04
Mercury	2.60E-04	3.04E-05	1.33E-04
Nickel	2.10E-03	2.45E-04	1.07E-03
Selenium	2.40E-05	2.80E-06	1.23E-05
Polycyclic Organic Matter:			
Methylnaphthalene (2-)	2.40E-05	2.80E-06	1.23E-05
Naphthalene	6.10E-04	7.13E-05	3.12E-04
Total HAP		**2.21E-01**	**9.67E-01**

[a] Emission factors from AP-42 Section 1.4 "Natural Gas Combustion" Tables 1.4-1, 1.4-2, & 1.4-3

[b] NO_x and CO emission factors from vendor guarantee.

[c] Emission Rate (lb/hr) = Rated Capacity (MMscf/hr) × Emission Factor (lb/MMscf) x (Actual Fuel HHV/1020).

[d] Annual Emissions $(tons/yr)_{Potential}$ = $(lb/hr)_{Emissions}$ × (Maximum Allowable Operating Hours, 8760 hr/yr) × (1 ton/2000 lb).

MarkWest Liberty Midstream & Resources L.L.C.
Majorsville Gas Plant

Stabilization Heater
(H-4782, H-6782)

Source Designation:	
Manufacturer:	Heatec
Year Installed	2014
Fuel Used:	Natural Gas
Higher Heating Value (HHV) (Btu/scf):	1,020
Heat Input (MMBtu/hr)	10.65
Fuel Consumption (mmscf/hr):	1.04E-02
Potential Annual Hours of Operation (hr/yr):	8,760

Criteria and Manufacturer Specific Pollutant Emission Rates

Pollutant	**Emission Factor (lb/MMscf)[a,b]**	**Potential Emissions (lb/hr)[c]**	**(tons/yr)[d]**
NO_x	59.84	0.625	2.737
CO	84	0.877	3.842
SO_2	0.6	0.006	0.0274
PM Total	7.6	0.079	0.3476
PM Condensable	5.7	0.060	0.261
PM_{10} (Filterable)	1.9	0.020	0.087
$PM_{2.5}$ (Filterable)	1.9	0.020	0.087
VOC	5.5	0.057	0.252

MarkWest Liberty Midstream & Resources L.L.C.
Majorsville Gas Plant

Stabilization Heater
(H-4782, H-6782)

Hazardous Air Pollutant (HAP) Potential Emissions

Pollutant	Emission Factor (lb/MMscf)[a]	Potential Emissions (lb/hr)[c]	Potential Emissions (tons/yr)[d]
HAPs:			
3-Methylchloranthrene	1.80E-06	1.88E-08	8.23E-08
7,12-Dimethylbenz(a)anthracene	1.60E-05	1.67E-07	7.32E-07
Acenaphthene	1.80E-06	1.88E-08	8.23E-08
Acenaphthylene	1.80E-06	1.88E-08	8.23E-08
Anthracene	2.40E-06	2.51E-08	1.10E-07
Benz(a)anthracene	1.80E-06	1.88E-08	8.23E-08
Benzene	2.10E-03	2.19E-05	9.61E-05
Benzo(a)pyrene	1.20E-06	1.25E-08	5.49E-08
Benzo(b)fluoranthene	1.80E-06	1.88E-08	8.23E-08
Benzo(g,h,i)perylene	1.20E-06	1.25E-08	5.49E-08
Benzo(k)fluoranthene	1.80E-06	1.88E-08	8.23E-08
Chrysene	1.80E-06	1.88E-08	8.23E-08
Dibenzo(a,h) anthracene	1.20E-06	1.25E-08	5.49E-08
Dichlorobenzene	1.20E-03	1.25E-05	5.49E-05
Fluoranthene	3.00E-06	3.13E-08	1.37E-07
Fluorene	2.80E-06	2.92E-08	1.28E-07
Formaldehyde	7.50E-02	7.83E-04	3.43E-03
Hexane	1.80E+00	1.88E-02	8.23E-02
Indo(1,2,3-cd)pyrene	1.80E-06	1.88E-08	8.23E-08
Phenanthrene	1.70E-05	1.78E-07	7.78E-07
Pyrene	5.00E-06	5.22E-08	2.29E-07
Toluene	3.40E-03	3.55E-05	1.56E-04
Arsenic	2.00E-04	2.09E-06	9.15E-06
Beryllium	1.20E-05	1.25E-07	5.49E-07
Cadmium	1.10E-03	1.15E-05	5.03E-05
Chromium	1.40E-03	1.46E-05	6.40E-05
Cobalt	8.40E-05	8.77E-07	3.84E-06
Lead	5.00E-04	5.22E-06	2.29E-05
Manganese	3.80E-04	3.97E-06	1.74E-05
Mercury	2.60E-04	2.72E-06	1.19E-05
Nickel	2.10E-03	2.19E-05	9.61E-05
Selenium	2.40E-05	2.51E-07	1.10E-06
Polycyclic Organic Matter:			
Methylnaphthalene (2-)	2.40E-05	2.51E-07	1.10E-06
Naphthalene	6.10E-04	6.37E-06	2.79E-05
Total HAP		**1.97E-02**	**8.64E-02**

[a] Emission factors from AP-42 Section 1.4 "Natural Gas Combustion" Tables 1.4-1, 1.4-2, & 1.4-3

[b] NO_x and CO emission factors from vendor guarantee.

[c] Emission Rate (lb/hr) = Rated Capacity (MMscf/hr) × Emission Factor (lb/MMscf) x (Actual Fuel HHV/1020).

[d] Annual Emissions $(tons/yr)_{Potential}$ = $(lb/hr)_{Emissions}$ × (Maximum Allowable Operating Hours, 8760 hr/yr) × (1 ton/2000 lb).

MarkWest Liberty Midstream & Resources L.L.C.
Majorsville Gas Plant

Compressor Engine Emissions (Per Engine)
(C102, C103, C104)

Source Designation:	
Manufacturer:	Caterpillar
Model No.:	G3608 LE
Stroke Cycle:	4-stroke
Type of Burn:	Lean
Year Installed/Date Manufactured	TBD
Fuel Used:	Natural Gas
Fuel High Heating Value (HHV) (Btu/scf):	1,124
Rated Horsepower (bhp):	2,370
Specific Fuel Consumption (Btu/bhp-hr)	6,629
Maximum Fuel Consumption at 100% Load (scf/hr):	13,978
Heat Input (MMBtu/hr)	15.71
Stack Designation:	TBD

Operational Details:

Potential Annual Hours of Operation (hr/yr):	8,760
Potential Fuel Consumption (MMscf/yr):	122.44

Criteria and Manufacturer Specific Pollutant Emission Factors:

Pollutant	**Emission Factors[a]**	**Units**
NOx	0.50	g/bhp-hr
CO (uncontrolled)	2.75	g/bhp-hr
CO (controlled)	0.19	g/bhp-hr
SO_2	5.88E-04	lb/MMBtu
PM_{10} (Filterable)	7.71E-05	lb/MMBtu
$PM_{2.5}$ (Filterable)	7.71E-05	lb/MMBtu
PM Condensable	9.91E-03	lb/MMBtu
PM Total	9.99E-03	lb/MMBtu
VOC (uncontrolled)	0.63	g/bhp-hr
VOC (controlled)	0.32	g/bhp-hr
Formaldehyde (HCHO) (uncontrolled)	0.40	g/bhp-hr
Formaldehyde (HCHO) (controlled)	0.08	g/bhp-hr

Criteria and Manufacturer Specific Pollutant Emission Rates

Pollutant	**Potential Emissions**	
	(lb/hr)[b]	**(tons/yr)[c]**
NO_x	2.61	11.44
CO (uncontrolled)	14.37	62.93
CO (controlled)	0.99	4.35
SO_2	0.01	0.04
PM_{10} (Filterable)	0.001	0.01
$PM_{2.5}$ (Filterable)	0.001	0.01
PM Condensable	0.16	0.68
PM Total	0.16	0.69
VOC (uncontrolled)	5.38	23.57
VOC (controlled)	2.09	9.15
Formaldehyde (HCHO) (uncontrolled)	2.09	9.15
Formaldehyde (HCHO) (controlled)	0.42	1.83

Compressor Engine Emissions (Per Engine)
(C102, C103, C104)

Hazardous Air Pollutant (HAP) Potential Emissions

Pollutant	Emission Factor (lb/MMBtu)[a]	Potential Emissions (lb/hr)[b]	Potential Emissions (tons/yr)[c]
HAPs:			
Acenaphthene	1.25E-06	1.96E-05	8.60E-05
Acenaphthylene	5.53E-06	8.69E-05	3.81E-04
Acetaldehyde	8.36E-03	1.31E-01	5.75E-01
Acrolein	5.14E-03	8.08E-02	3.54E-01
Benzene	4.40E-04	6.91E-03	3.03E-02
Benzo(b)fluoranthene	1.66E-07	2.61E-06	1.14E-05
Benzo(e)pyrene	4.15E-07	6.52E-06	2.86E-05
Benzo(g,h,i)perlyene	4.14E-07	6.50E-06	2.85E-05
Biphenyl	2.12E-04	3.33E-03	1.46E-02
1,3-Butadiene	2.67E-04	4.19E-03	1.84E-02
Carbon Tetrachloride	3.67E-05	5.77E-04	2.53E-03
Chlorobenzene	3.04E-05	4.78E-04	2.09E-03
Chloroform	2.85E-05	4.48E-04	1.96E-03
Chrysene	6.93E-07	1.09E-05	4.77E-05
1,3-Dichloropropene	2.64E-05	4.15E-04	1.82E-03
Ethylbenzene	3.97E-05	6.24E-04	2.73E-03
Ethylene Dibromide	4.43E-05	6.96E-04	3.05E-03
Fluoranthene	1.11E-06	1.74E-05	7.64E-05
Fluorene	5.67E-06	8.91E-05	3.90E-04
Methanol	2.50E-03	3.93E-02	1.72E-01
Methylene Chloride	2.00E-05	3.14E-04	1.38E-03
n-Hexane	1.11E-03	1.74E-02	7.64E-02
Phenanthrene	1.04E-05	1.63E-04	7.16E-04
Phenol	2.40E-05	3.77E-04	1.65E-03
Pyrene	1.36E-06	2.14E-05	9.36E-05
Styrene	2.36E-05	3.71E-04	1.62E-03
Toluene	4.08E-04	6.41E-03	2.81E-02
1,1,2,2-Tetrachloroethane	4.00E-05	6.28E-04	2.75E-03
Tetrachloroethane	2.48E-06	3.90E-05	1.71E-04
1,1,2-Trichloroethane	3.18E-05	5.00E-04	2.19E-03
2,2,4-Trimethylpentane	2.50E-04	3.93E-03	1.72E-02
Vinyl Chloride	1.49E-05	2.34E-04	1.03E-03
Xylene	1.84E-04	2.89E-03	1.27E-02
Polycyclic Organic Matter:			
Naphthalene	7.44E-05	1.17E-03	5.12E-03
2-Methylnaphthalene	3.32E-05	5.22E-04	2.28E-03
PAH	2.69E-05	4.23E-04	1.85E-03
Total HAP		**0.72**	**3.17**

[a] SO_2, PM, and HAP emission factors from AP-42 Section 3.2, Table 3.2-2"Uncontrolled Emission Factors for 4-Stroke Lean-Burn Engines,"

[b] Emission Rate (lb/hr) = Rated Capacity (MMBtu/hr or bhp) × Emission Factor (lb/MMBtu or lb/bhp-hr).

[c] Annual Emissions $(tons/yr)_{Potential} = (lb/hr)_{Emissions} \times$ (Maximum Allowable Operating Hours, 8,760 hr/yr) × (1 ton/2000 lb).

MarkWest Liberty Midstream & Resources L.L.C.
Majorsville Gas Plant

Summary of Potential Emissions

Criteria Pollutant Potential Emissions

Process/Facility	Potential Emissions (lb/hr)					
	NOx	CO	VOC	SO_2	PM[1]	HAPs
Compressor Engine (C-102)	2.61	0.99	2.09	0.01	0.16	0.72
Compressor Engine (C-103)	2.61	0.99	2.09	0.01	0.16	0.72
Compressor Engine (C-104)	2.61	0.99	2.09	0.01	0.16	0.72
Regeneration Heater (H-741)	0.30	0.46	0.03	0.00	0.04	0.01
Regeneration Heater (H-2741)	0.30	0.46	0.03	0.00	0.04	0.01
Regeneration Heater (H-3741)	0.41	0.32	0.04	0.00	0.06	0.01
Regeneration Heater (H-4741)	0.41	0.32	0.04	0.00	0.06	0.01
Regeneration Heater (H-5741)	0.41	0.32	0.04	0.00	0.06	0.01
Regeneration Heater (H-6741)	0.41	0.32	0.04	0.00	0.06	0.01
Regeneration Heater (H-7741)	**0.41**	**0.32**	**0.04**	**0.00**	**0.06**	**0.01**
Hot Oil Heater (H-781)	1.33	1.27	0.08	0.01	0.11	0.03
Hot Oil Heater (H-3781)	1.61	1.32	0.09	0.01	0.12	0.03
Hot Oil Heater (H-4781)	1.61	1.32	0.09	0.01	0.12	0.03
Hot Oil Heater (H-7781)	**1.61**	**1.32**	**0.09**	**0.01**	**0.12**	**0.03**
DeEthanizer HMO (H-1782)	3.58	4.77	0.64	0.07	0.89	0.22
DeEthanizer HMO (H-D2782)	**3.58**	**4.77**	**0.64**	**0.07**	**0.89**	**0.22**
DeEthanizer Regeneration Heater (H-1741)	0.57	0.58	0.27	0.01	0.19	0.03
DeEthanizer Regeneration Heater (H-D2741)	**0.57**	**0.58**	**0.27**	**0.01**	**0.19**	**0.03**
Stabilization Heater (H-4782)	0.62	0.88	0.06	0.01	0.08	0.02
Majorsville I & II Emergency Gen (M1-G-1)	**1.12**	**1.68**	**0.56**	**0.00**	**0.02**	**0.04**
Majorsville III Emergency Gen (M3-G-2)	**0.70**	**0.18**	**0.02**	**0.58**	**0.23**	**0.01**
Majorsville III MCC Emergency Gen (M3-G-3)	**0.70**	**0.18**	**0.02**	**0.58**	**0.23**	**0.01**
Majorsville IV MCC Emergency Gen (M4-G-6)	**0.70**	**0.18**	**0.02**	**0.58**	**0.23**	**0.01**
Majorsville IV Emergency Gen (M4-G-7)	**0.70**	**0.18**	**0.02**	**0.58**	**0.23**	**0.01**
Majorsville VII Emergency Gen (M7-G-8)	**0.70**	**0.18**	**0.02**	**0.58**	**0.23**	**0.01**
Majorsville VII MCC Emergency Gen (M7-G-9)	**0.70**	**0.18**	**0.02**	**0.58**	**0.23**	**0.01**
DeEth I Control Room Emergency Gen (MD1-G-4)	**0.41**	**0.43**	**0.41**	**0.11**	**0.00**	**0.00**
DeEth I Emergency Gen (MD1-G-5)	**0.25**	**0.29**	**0.25**	**0.07**	**0.00**	**0.00**
DeEth II Control Room Emergency Gen (MD2-G-10)	**0.41**	**0.43**	**0.41**	**0.11**	**0.00**	**0.00**
DeEth II Emergency Gen (MD2-G-11)	**0.25**	**0.29**	**0.25**	**0.07**	**0.00**	**0.00**
Emergency Flare (FL-991) - MI, II, III, V	0.05	0.04	0.00	0.00	0.00	--
Emergency Flare (FL-1991) - DeEth, MIV, MVI, MVII	**0.49**	**2.47**	**0.00**	**0.00**	**0.00**	--
Blowdown Emissions	--	--	0.40	--	--	0.02
Fugitive Emissions (FUG-001)	--	--	**8.76**	--	--	**0.07**
Site Wide Emissions (lb/hr)	**32.76**	**29.01**	**19.90**	**4.07**	**4.96**	**3.11**

[1] $PM = PM_{10} = PM_{2.5}$

MarkWest Liberty Midstream & Resources L.L.C.
Majorsville Gas Plant

Summary of Potential Emissions

Process/Facility	Potential Emissions (tpy)					
	NOx	CO	VOC	SO_2	PM[1]	HAPs
Compressor Engine (C-102)	11.44	4.35	9.15	0.04	0.69	3.17
Compressor Engine (C-103)	11.44	4.35	9.15	0.04	0.69	3.17
Compressor Engine (C-104)	11.44	4.35	9.15	0.04	0.69	3.17
Regeneration Heater (H-741)	1.32	2.02	0.13	0.01	0.18	0.05
Regeneration Heater (H-2741)	1.32	2.02	0.13	0.01	0.18	0.05
Regeneration Heater (H-3741)	1.80	1.38	0.18	0.02	0.25	0.06
Regeneration Heater (H-4741)	1.80	1.38	0.18	0.02	0.25	0.06
Regeneration Heater (H-5741)	1.80	1.38	0.18	0.02	0.25	0.06
Regeneration Heater (H-6741)	1.80	1.38	0.18	0.02	0.25	0.06
Regeneration Heater (H-7741)	**1.80**	**1.38**	**0.18**	**0.02**	**0.25**	**0.06**
Hot Oil Heater (H-781)	5.85	5.55	0.36	0.04	0.50	0.12
Hot Oil Heater (H-3781)	7.04	5.80	0.38	0.04	0.52	0.13
Hot Oil Heater (H-4781)	7.04	5.80	0.38	0.04	0.52	0.13
Hot Oil Heater (H-7781)	**7.04**	**5.80**	**0.38**	**0.04**	**0.52**	**0.13**
DeEthanizer HMO (H-1782)	15.66	20.88	2.82	0.31	3.89	0.97
DeEthanizer HMO (H-D2782)	**15.66**	**20.88**	**2.82**	**0.31**	**3.89**	**0.97**
DeEthanizer Regeneration Heater (H-1741)	2.50	2.56	1.19	0.04	0.81	0.12
DeEthanizer Regeneration Heater (H-D2741)	**2.50**	**2.56**	**1.19**	**0.04**	**0.81**	**0.12**
Stabilization Heater (H-4782)	2.74	3.84	0.25	0.03	0.35	0.09
Majorsville I & II Emergency Gen (M1-G-1)	**0.28**	**0.42**	**0.14**	**0.00**	**0.01**	**0.01**
Majorsville III Emergency Gen (M3-G-2)	**0.18**	**0.04**	**0.00**	**0.14**	**0.06**	**0.00**
Majorsville III MCC Emergency Gen (M3-G-3)	**0.18**	**0.04**	**0.00**	**0.14**	**0.06**	**0.00**
Majorsville IV MCC Emergency Gen (M4-G-6)	**0.18**	**0.04**	**0.00**	**0.14**	**0.06**	**0.00**
Majorsville IV Emergency Gen (M4-G-7)	**0.18**	**0.04**	**0.00**	**0.14**	**0.06**	**0.00**
Majorsville VII Emergency Gen (M7-G-8)	**0.18**	**0.04**	**0.00**	**0.14**	**0.06**	**0.00**
Majorsville VII MCC Emergency Gen (M7-G-9)	**0.18**	**0.04**	**0.00**	**0.14**	**0.06**	**0.00**
DeEth I Control Room Emergency Gen (MD1-G-4)	**0.10**	**0.11**	**0.10**	**0.03**	**0.00**	**0.00**
DeEth I Emergency Gen (MD1-G-5)	**0.06**	**0.07**	**0.06**	**0.02**	**0.00**	**0.00**
DeEth II Control Room Emergency Gen (MD2-G-10)	**0.10**	**0.11**	**0.10**	**0.03**	**0.00**	**0.00**
DeEth II Emergency Gen (MD2-G-11)	**0.06**	**0.07**	**0.06**	**0.02**	**0.00**	**0.00**
Emergency Flare (FL-991) - MI, II, III, V	0.22	0.18	0.01	0.00	0.02	--
Emergency Flare (FL-1991) - DeEth, MIV, MVI, MVII	**0.20**	**0.26**	**0.01**	**0.00**	**0.01**	--
Blowdown Emissions	--	--	1.75	--	--	0.08
Fugitive Emissions (FUG-001)	--	--	**38.38**	--	--	**0.29**
Site Wide Emissions (tpy)	**114.06**	**99.15**	**79.04**	**2.08**	**15.89**	**13.07**

[1] $PM = PM_{10} = PM_{2.5}$

MarkWest Liberty Midstream & Resources L.L.C.
Majorsville Gas Plant

Summary of Potential Emissions

Hazardous Air Pollutant Potential Emissions

Process/Facility	HAPs - Potential Emissions (lb/hr)					
	Benzene	Ethylbenzene	Toluene	Xylenes	n-Hexane	Formaldehyde
Compressor Engine (C-102)	6.91E-03	6.24E-04	6.41E-03	2.89E-03	1.74E-02	4.18E-01
Compressor Engine (C-103)	6.91E-03	6.24E-04	6.41E-03	2.89E-03	1.74E-02	4.18E-01
Compressor Engine (C-104)	6.91E-03	6.24E-04	6.41E-03	2.89E-03	1.74E-02	4.18E-01
Regeneration Heater (H-741)	1.15E-05	--	1.87E-05	--	9.88E-03	4.12E-04
Regeneration Heater (H-2741)	1.15E-05	--	1.87E-05	--	9.88E-03	4.12E-04
Regeneration Heater (H-3741)	1.58E-05	--	2.56E-05	--	1.36E-02	5.65E-04
Regeneration Heater (H-4741)	1.58E-05	--	2.56E-05	--	1.36E-02	5.65E-04
Regeneration Heater (H-5741)	1.58E-05	--	2.56E-05	--	1.36E-02	5.65E-04
Regeneration Heater (H-6741)	1.58E-05	--	2.56E-05	--	1.36E-02	5.65E-04
Regeneration Heater (H-7741)	**1.58E-05**	--	**2.56E-05**	--	**1.36E-02**	**5.65E-04**
Hot Oil Heater (H-781)	3.17E-05	--	5.13E-05	--	2.72E-02	1.13E-03
Hot Oil Heater (H-3781)	3.31E-05	--	5.36E-05	--	2.84E-02	1.18E-03
Hot Oil Heater (H-4781)	3.31E-05	--	5.36E-05	--	2.84E-02	1.18E-03
Hot Oil Heater (H-7781)	**3.31E-05**	--	**5.36E-05**	--	**2.84E-02**	**1.18E-03**
DeEthanizer HMO (H-1782)	2.45E-04	--	3.97E-04	--	2.10E-01	8.76E-03
DeEthanizer HMO (H-D2782)	**2.45E-04**	--	**3.97E-04**	--	**2.10E-01**	**8.76E-03**
DeEthanizer Regeneration Heater (H-1741)	2.93E-05	--	4.75E-05	--	2.51E-02	1.05E-03
DeEthanizer Regeneration Heater (H-D2741)	**2.93E-05**	--	**4.75E-05**	--	**2.51E-02**	**1.05E-03**
Stabilization Heater (H-4782)	2.19E-05	--	3.55E-05	--	1.88E-02	7.83E-04
Majorsville I & II Emergency Gen (M1-G-1)	**9.25E-04**	**8.35E-05**	**8.58E-04**	**3.87E-04**	--	**5.36E-03**
Majorsville III Emergency Gen (M3-G-2)	**3.59E-03**	--	**1.57E-03**	--	--	**4.54E-03**
Majorsville III MCC Emergency Gen (M3-G-3)	**3.59E-03**	--	**1.57E-03**	--	--	**4.54E-03**
Majorsville IV MCC Emergency Gen (M4-G-6)	**3.59E-03**	--	**1.57E-03**	--	--	**4.54E-03**
Majorsville IV Emergency Gen (M4-G-7)	**3.59E-03**	--	**1.57E-03**	--	--	**4.54E-03**
Majorsville VII Emergency Gen (M7-G-8)	**3.59E-03**	--	**1.57E-03**	--	--	**4.54E-03**
Majorsville VII MCC Emergency Gen (M7-G-9)	**3.59E-03**	--	**1.57E-03**	--	--	**4.54E-03**
DeEth I Control Room Emergency Gen (MD1-G-4)	**3.85E-04**	--	**1.69E-04**	--	--	**4.86E-04**
DeEth I Emergency Gen (MD1-G-5)	**2.31E-04**	--	**1.01E-04**	--	--	**2.92E-04**
DeEth II Control Room Emergency Gen (MD2-G-10)	**3.85E-04**	--	**1.69E-04**	--	--	**4.86E-04**
DeEth II Emergency Gen (MD2-G-11)	**2.31E-04**	--	**1.01E-04**	--	--	**2.92E-04**
Emergency Flare (FL-991) - MI, II, III, V	--	--	--	--	--	--
Emergency Flare (FL-1991) - DeEth, MIV, MVI, MVII	--	--	--	--	--	--
Blowdown Emissions	--	--	--	--	--	--
Fugitive Emissions (FUG-001)	--	--	--	--	--	--
Site Wide Emissions (lb/hr)	**0.05**	**0.00**	**0.03**	**0.01**	**0.74**	**1.32**

MarkWest Liberty Midstream & Resources L.L.C.
Majorsville Gas Plant

Summary of Potential Emissions

Process/Facility	HAPs - Potential Emissions (tpy)					
	Benzene	Ethylbenzene	Toluene	Xylenes	n-Hexane	Formaldehyde
Compressor Engine (C-102)	3.03E-02	2.73E-03	2.81E-02	1.27E-02	7.64E-02	1.83E+00
Compressor Engine (C-103)	3.03E-02	2.73E-03	2.81E-02	1.27E-02	7.64E-02	1.83E+00
Compressor Engine (C-104)	3.03E-02	2.73E-03	2.81E-02	1.27E-02	7.64E-02	1.83E+00
Regeneration Heater (H-741)	5.05E-05	--	8.18E-05	--	4.33E-02	1.80E-03
Regeneration Heater (H-2741)	5.05E-05	--	8.18E-05	--	4.33E-02	1.80E-03
Regeneration Heater (H-3741)	6.93E-05	--	1.12E-04	--	5.94E-02	2.48E-03
Regeneration Heater (H-4741)	6.93E-05	--	1.12E-04	--	5.94E-02	2.48E-03
Regeneration Heater (H-5741)	6.93E-05	--	1.12E-04	--	5.94E-02	2.48E-03
Regeneration Heater (H-6741)	6.93E-05	--	1.12E-04	--	5.94E-02	2.48E-03
Regeneration Heater (H-7741)	**6.93E-05**	--	**1.12E-04**	--	**5.94E-02**	**2.48E-03**
Hot Oil Heater (H-781)	1.39E-04	--	2.25E-04	--	1.19E-01	4.96E-03
Hot Oil Heater (H-3781)	1.45E-04	--	2.35E-04	--	1.24E-01	5.18E-03
Hot Oil Heater (H-4781)	1.45E-04	--	2.35E-04	--	1.24E-01	5.18E-03
Hot Oil Heater (H-7781)	**1.45E-04**	--	**2.35E-04**	--	**1.24E-01**	**5.18E-03**
DeEthanizer HMO (H-1782)	1.07E-03	--	1.74E-03	--	9.21E-01	3.84E-02
DeEthanizer HMO (H-D2782)	**1.07E-03**	--	**1.74E-03**	--	**9.21E-01**	**3.84E-02**
DeEthanizer Regeneration Heater (H-1741)	1.29E-04	--	2.08E-04	--	1.10E-01	4.59E-03
DeEthanizer Regeneration Heater (H-D2741)	**1.29E-04**	--	**2.08E-04**	--	**1.10E-01**	**4.59E-03**
Stabilization Heater (H-4782)	9.61E-05	--	1.56E-04	--	8.23E-02	3.43E-03
Majorsville I & II Emergency Gen (M1-G-1)	**2.31E-04**	**2.09E-05**	**2.14E-04**	**9.67E-05**	--	**1.34E-03**
Majorsville III Emergency Gen (M3-G-2)	**8.97E-04**	--	**3.93E-04**	--	--	**1.13E-03**
Majorsville III MCC Emergency Gen (M3-G-3)	**8.97E-04**	--	**3.93E-04**	--	--	**1.13E-03**
Majorsville IV MCC Emergency Gen (M4-G-6)	**8.97E-04**	--	**3.93E-04**	--	--	**1.13E-03**
Majorsville IV Emergency Gen (M4-G-7)	**8.97E-04**	--	**3.93E-04**	--	--	**1.13E-03**
Majorsville VII Emergency Gen (M7-G-8)	**8.97E-04**	--	**3.93E-04**	--	--	**1.13E-03**
Majorsville VII MCC Emergency Gen (M7-G-9)	**8.97E-04**	--	**3.93E-04**	--	--	**1.13E-03**
DeEth I Control Room Emergency Gen (MD1-G-4)	**9.61E-05**	--	**4.21E-05**	--	--	**1.22E-04**
DeEth I Emergency Gen (MD1-G-5)	**5.77E-05**	--	**2.53E-05**	--	--	**7.29E-05**
DeEth II Control Room Emergency Gen (MD2-G-10)	**9.61E-05**	--	**4.21E-05**	--	--	**1.22E-04**
DeEth II Emergency Gen (MD2-G-11)	**5.77E-05**	--	**2.53E-05**	--	--	**7.29E-05**
Emergency Flare (FL-991) - MI, II, III, V	--	--	--	--	--	--
Emergency Flare (FL-1991) - DeEth, MIV, MVI, MVII	--	--	--	--	--	--
Blowdown Emissions	--	--	--	--	--	--
Fugitive Emissions (FUG-001)	--	--	--	--	--	--
Site Wide Emissions (tpy)	**0.10**	**0.01**	**0.09**	**0.04**	**3.25**	**5.63**

MarkWest Liberty Midstream & Resources L.L.C.
Majorsville Gas Plant

Emergency Flare
(FL-991)

Source Designation:	
Manufacturer:	Superior Fabrication
Year Installed	2010
Operating Hours: (hr/yr)	8,760
Flow Rate per Pilot (scfm)	1.39
Number of Pilots	6.00
Pilot Gas Volume (scfm)	8.34
Purge Gas Volume (scfm)	0.00
Annual Fuel Use (MMBtu/yr)	4,471
Annual Fuel Use (mmscf/yr)	4.4
Fuel Consumption (mmscf/hr):	5.0E-04
Fuel HHV (Btu/scf)	1,020

Criteria and Manufacturer Specific Pollutant Emission Rates

Pollutant	**Emission Factor (lb/MMscf)[a]**	**Potential Emissions (lb/hr)[b]**	**(tons/yr)[c]**
NO_x	100	0.050	0.219
CO	84	0.042	0.184
SO_2	0.6	0.000	0.001
PM Total	7.6	0.004	0.017
PM Condensable	1.9	0.001	0.004
PM_{10} (Filterable)	5.7	0.003	0.012
$PM_{2.5}$ (Filterable)	5.7	0.003	0.012
VOC	5.5	0.003	0.012

[a] Emission factors from AP-42 Section 1.4 "Natural Gas Combustion" Tables 1.4-1.

[b] Emission Rate (lb/hr) = Rated Capacity (MMscf/hr) × Emission Factor (lb/MMscf).

[c] Annual Emissions $(tons/yr)_{Potential} = (lb/hr)_{Emissions}$ × (Maximum Allowable Operating Hours, 8760 hr/yr) × (1 ton/2000 lb).

MarkWest Liberty Midstream & Resources L.L.C.
Majorsville Gas Plant

Plant Flare
(FL-1991)

Source Designation:	
Manufacturer:	Callidus
Year Installed	2012/2013
Operating Hours: (hr/yr)	8,760
Flow Rate per Pilot (scfm)	1.39
Number of Pilots	5.00
Pilot Gas Volume (scfm)	6.95
Purge Gas Volume (scfm)	0.00
Annual Fuel Use (MMBtu/yr)	3,726
Annual Fuel Use (mmscf/yr)	3.65
Fuel Consumption (mmscf/hr):	4.2E-04
Fuel HHV (Btu/scf)	1,020

Criteria and Manufacturer Specific Pollutant Emission Rates

Pollutant	Emission Factor (lb/MMscf)[a]	Potential Emissions (lb/hr)[b]	(tons/yr)[c]
NO_x	100	0.042	0.183
CO	84	0.035	0.153
SO_2	0.6	0.000	0.001
PM Total	7.6	0.003	0.014
PM Condensable	1.9	0.001	0.003
PM_{10} (Filterable)	5.7	0.002	0.010
$PM_{2.5}$ (Filterable)	5.7	0.002	0.010
VOC	5.5	0.002	0.010

[a] Emission factors from AP-42 Section 1.4 "Natural Gas Combustion" Tables 1.4-1.

[b] Emission Rate (lb/hr) = Rated Capacity (MMscf/hr) × Emission Factor (lb/MMscf).

[c] Annual Emissions $(tons/yr)_{Potential}$ = $(lb/hr)_{Emissions}$ × (Maximum Allowable Operating Hours, 8760 hr/yr) × (1 ton/2000 lb).

Combustion of Hydrocarbons

Source Designation:	
Hourly maintenance emissions (lb/hr)[b]	348.43
Annual maintenance emissions (tpy)[b]	45.20
MW	20.44
Hourly Gas Flow (scf/hr)	6,462
Annual Gas Flow (mmscf/yr)	1.68
Heating value (btu/scf)	1,020.00
Maximum Heat Release of Flare (mmbtu/hr)	6.6
Maximum Heat Release of Flare (mmbtu/yr)	554
NO_X Emission Rate (lb/mmbtu)	0.068
CO Emission Rate (lb/mmbtu)	0.37

[a] Emission factors from AP-42 Section 13.5 "Industrial Flares" Table 13.5-1

[b] Includes emissions from pump maintenance and pigging

Total Emissions

Pollutant	lb/hr	tpy
NO_X	0.4899	0.2015
CO	2.4738	0.2559
SO_2	0.0003	0.0011
PM Total	0.0032	0.0139
PM Condensable	0.0008	0.0035
PM_{10} (Filterable)	0.0024	0.0104
$PM_{2.5}$ (Filterable)	0.0024	0.0104
VOC	0.0023	0.0100

GHG Calculations
MarkWest Liberty Midstream & Resources L.L.C.
Majorsville Gas Plant

Source	$CO_2(e)$ CO_2 Emission Rate (tpy)	$CO_2(e)$ CH_4 Emission Rate (tpy)	$CO_2(e)$ N_2O Emission Rate (tpy)
Reboiler/Heaters & Flares	226,617.87	89.76	132.50
Natural gas Engines	27,376.74	10.84	16.01
Diesel Engines	994.57	0.85	2.50
Fugitives	0.13	553.27	-
Blowdown Emissions	0.80	2,841.50	-
Total Emissions	**254,990.11**	**3,496.22**	**151.01**

Total CO_2 Equivalent	**258,637.34**

GHG Calculations
MarkWest Liberty Midstream & Resources L.L.C.
Majorsville Gas Plant

Fugitive GHG Calculation

Equipment type	Stream Type (Gas/Liquid etc)	Total Emissions (tpy)	CH_4 * Wt%	CO_2 * Wt%	CO_2 (tpy)	CO_2(e) from CH_4
Compressors	Gas	0.4081	61.82	0.29	0.00	5.30
Compressors	Light Oil	0.0109	0.494	0.002	0.00	0.00
Flange	Gas	7.6681	61.82	0.29	0.02	99.55
Flange	Gas	4.8615	61.82	0.29	0.01	63.11
Flange	Gas	0.1873	61.82	0.29	0.00	2.43
Flange	Light Oil	1.8124	0.494	0.002	0.00	0.19
Flange	Light Oil	0.0275	0.494	0.002	0.00	0.00
Flange	Heavy Oil	0.0000	0.494	0.002	0.00	0.00
Connector	Gas	10.9151	61.82	0.29	0.03	141.70
Connector	Gas	8.7345	61.82	0.29	0.03	113.39
Connector	Gas	0.2016	61.82	0.29	0.00	2.62
Connector	Light Oil	6.7680	0.494	0.002	0.00	0.70
Connector	Light Oil	0.2571	0.494	0.002	0.00	0.03
PRD	Gas	0.1582	61.82	0.29	0.00	2.05
PRD	Gas	0.3622	61.82	0.29	0.00	4.70
PRD	Gas	0.0204	61.82	0.29	0.00	0.26
PRD	Light Oil	0.0913	0.494	0.002	0.00	0.01
Pump	Gas	0.0974	61.82	0.29	0.00	1.26
Pump	Light Oil	0.7160	0.494	0.002	0.00	0.07
Valve	Gas	4.4219	61.82	0.29	0.01	57.41
Valve	Gas	4.1219	61.82	0.29	0.01	53.51
Valve	Gas	0.3652	61.82	0.29	0.00	4.74
Valve	Heavy Oil	0.0000	0.494	0.002	0.00	0.00
Valve	Heavy Oil	0.0000	0.494	0.002	0.00	0.00
Valve	Light Oil	2.0928	0.494	0.002	0.00	0.22
CO_2(e) from CH_4					0.13	553.27

*Taken from Gas Analysis and Condensate Analysis

GHG Vented Blowdown Emissions

Blowdown Emissions Sources	Number of Units	Vented Gas Volume Per Blowdown Event (scf)	Number of Blowdown Events per year	Total Volume NG Emitted (scf/yr)	Potential CH_4 Emissions[1] (tpy)	Potential CO_2 Emissions[1] (tpy)	Potential CO_2e Emissions (tpy)
Engines	3	2,200	36	237,600	3.1	0.018	65
Majorsville I&II	2	182,525	4	1,460,200	19.0	0.113	400
Majorsville III & IV	2	250,000	4	2,000,000	26.1	0.155	548
Majorsville V, VI, VII	3	250,000	4	3,000,000	39.1	0.233	822
Deethanzier	2	459,000	4	3,672,000	47.9	0.285	1006
Total					**135.3**	**0.804**	**2842**

1. Calculated in accordance with Equations W-35 and W-36 in Subpart W of 40 CFR 98.

GHG Calculations
MarkWest Liberty Midstream & Resources L.L.C.
Majorsville Gas Plant

Reboiler/Heaters & Flares

Equipment	Heat Input (LHV) (mmbtu/hr)	Heat Input (HHV) (mmbtu/hr)	Emission Factors CO_2 (lb/mmbtu)	Emission Factors CH_4 (lb/mmbtu)	Emission Factors N_2O (lb/mmbtu)	$CO_2(e)$ CO_2 Emission Rate (tpy)	$CO_2(e)$ CH_4 Emission Rate (tpy)	$CO_2(e)$ N_2O Emission Rate (tpy)
Flare Pilot F-991	0.5100	0.5610	116.887892	0.0022046	0.00022046	287.21	0.11	0.17
Flare Pilot F-1991	0.43	0.4675	116.887892	0.0022046	0.00022046	239.35	0.09	0.14
Heater H-741	5.60	6.1600	116.887892	0.0022046	0.00022046	3,153.73	1.25	1.84
Heater H-2741	5.60	6.1600	116.887892	0.0022046	0.00022046	3,153.73	1.25	1.84
Heater H-3741	7.69	8.4590	116.887892	0.0022046	0.00022046	4,330.75	1.72	2.53
Heater H-4741	7.69	8.4590	116.887892	0.0022046	0.00022046	4,330.75	1.72	2.53
Heater H-5741	7.69	8.4590	116.887892	0.0022046	0.00022046	4,330.75	1.72	2.53
Heater H-6741	7.69	8.4590	116.887892	0.0022046	0.00022046	4,330.75	1.72	2.53
Heater H-7741	7.69	8.4590	116.887892	0.0022046	0.00022046	4,330.75	1.72	2.53
Heater H-781	15.40	16.9400	116.887892	0.0022046	0.00022046	8,672.75	3.44	5.07
Heater H-3781	16.07	17.6770	116.887892	0.0022046	0.00022046	9,050.08	3.58	5.29
Heater H-4781	16.07	17.6770	116.887892	0.0022046	0.00022046	9,050.08	3.58	5.29
Heater H-7781	16.07	17.6770	116.887892	0.0022046	0.00022046	9,050.08	3.58	5.29
Heater H-1782	119.20	131.1200	116.887892	0.0022046	0.00022046	67,129.37	26.59	39.25
Heater H-D2782	119.20	131.1200	116.887892	0.0022046	0.00022046	67,129.37	26.59	39.25
Heater H-1741	14.25	15.6750	116.887892	0.0022046	0.00022046	8,025.11	3.18	4.69
Heater H-D2741	14.25	15.6750	116.887892	0.0022046	0.00022046	8,025.11	3.18	4.69
Heater H-4782	10.65	11.7177	116.887892	0.0022046	0.00022046	5,999.09	2.38	3.51
Heater H-6782	10.65	11.7177	116.887892	0.0022046	0.00022046	5,999.09	2.38	3.51
Total						226,617.87	89.76	132.50

Natural gas Engines

Equipment	HP	Fuel Use (HHV) (btu/bhp-hr)	Fuel Use (HHV) (mmbtu/yr)	Emission Factors CO_2 (lb/mmbtu)	Emission Factors CH_4 (lb/mmbtu)	Emission Factors N_2O (lb/mmbtu)	$CO_2(e)$ CO_2 Emission Rate (tpy)	$CO_2(e)$ CH_4 Emission Rate (tpy)	$CO_2(e)$ N_2O Emission Rate (tpy)
C-102	2,370	7504	155792.045	116.887892	0.0022046	0.00022046	9,105.10	3.61	5.32
C-103	2,370	7504	155792.045	116.887892	0.0022046	0.00022046	9,105.10	3.61	5.32
C-104	2,370	7504	155792.045	116.887892	0.0022046	0.00022046	9,105.10	3.61	5.32
M1-G-1	254	472	1051.11	116.887892	0.0022046	0.00022046	61.43	0.02	0.04
Total							27,376.74	10.84	16.01

Diesel Engines

Equipment	HP	Fuel Use (gal/hr)	Heat Content (HHV) (btu/gal)	Fuel Use (HHV) (mmbtu/yr)	Emission Factors CO_2 (lb/mmbtu)	Emission Factors CH_4 (lb/mmbtu)	Emission Factors N_2O (lb/mmbtu)	$CO_2(e)$ CO_2 Emission Rate (tpy)	$CO_2(e)$ CH_4 Emission Rate (tpy)	$CO_2(e)$ N_2O Emission Rate (tpy)
M3-G-2	145	28	137,380	1923	163.052216	0.0066138	0.00132276	156.80	0.13	0.39
M3-G-3	145	28	137,380	1923	163.052216	0.0066138	0.00132276	156.80	0.13	0.39
M4-G-6	145	28	137,380	1923	163.052216	0.0066138	0.00132276	156.80	0.13	0.39
M4-G-7	145	28	137,380	1923	163.052216	0.0066138	0.00132276	156.80	0.13	0.39
M7-G-8	145	28	137,380	1923	163.052216	0.0066138	0.00132276	156.80	0.13	0.39
M7-G-9	145	28	137,380	1923	163.052216	0.0066138	0.00132276	156.80	0.13	0.39
MD1-G-4	53	3	137,380	206	163.052216	0.0066138	0.00132276	16.80	0.01	0.04
MD1-G-5	32	1.8	137,380	124	163.052216	0.0066138	0.00132276	10.08	0.01	0.03
MD2-G-10	53	3	137,380	206	163.052216	0.0066138	0.00132276	16.80	0.01	0.04
MD2-G-11	32	1.8	137,380	124	163.052216	0.0066138	0.00132276	10.08	0.01	0.03
Total								994.57	0.85	2.50

MarkWest Liberty Midstream & Resources L.L.C.
Majorsville Gas Plant

Regeneration Heaters
(H-741 & H-2741)

Source Designation:	
Manufacturer:	Heatec
Year Installed	2010
Fuel Used:	Natural Gas
Higher Heating Value (HHV) (Btu/scf):	1,020
Heat Input (MMBtu/hr)	5.60
Fuel Consumption (mmscf/hr):	5.49E-03
Potential Annual Hours of Operation (hr/yr):	8,760

Criteria and Manufacturer Specific Pollutant Emission Rates

Pollutant	Emission Factor (lb/MMscf)[a,b]	Potential Emissions (lb/hr)[c]	Potential Emissions (tons/yr)[d]
NO_x	55	0.302	1.323
CO	84	0.461	2.020
SO_2	0.6	0.003	0.0144
PM Total	7.6	0.042	0.1828
PM Condensable	5.7	0.031	0.137
PM_{10} (Filterable)	1.9	0.010	0.046
$PM_{2.5}$ (Filterable)	1.9	0.010	0.046
VOC	5.5	0.030	0.132

MarkWest Liberty Midstream & Resources L.L.C.
Majorsville Gas Plant

Regeneration Heaters
(H-741 & H-2741)

Hazardous Air Pollutant (HAP) Potential Emissions

Pollutant	Emission Factor (lb/MMscf)[a]	Potential Emissions (lb/hr)[c]	Potential Emissions (tons/yr)[d]
HAPs:			
3-Methylchloranthrene	1.80E-06	9.88E-09	4.33E-08
7,12-Dimethylbenz(a)anthracene	1.60E-05	8.78E-08	3.85E-07
Acenaphthene	1.80E-06	9.88E-09	4.33E-08
Acenaphthylene	1.80E-06	9.88E-09	4.33E-08
Anthracene	2.40E-06	1.32E-08	5.77E-08
Benz(a)anthracene	1.80E-06	9.88E-09	4.33E-08
Benzene	2.10E-03	1.15E-05	5.05E-05
Benzo(a)pyrene	1.20E-06	6.59E-09	2.89E-08
Benzo(b)fluoranthene	1.80E-06	9.88E-09	4.33E-08
Benzo(g,h,i)perylene	1.20E-06	6.59E-09	2.89E-08
Benzo(k)fluoranthene	1.80E-06	9.88E-09	4.33E-08
Chrysene	1.80E-06	9.88E-09	4.33E-08
Dibenzo(a,h) anthracene	1.20E-06	6.59E-09	2.89E-08
Dichlorobenzene	1.20E-03	6.59E-06	2.89E-05
Fluoranthene	3.00E-06	1.65E-08	7.21E-08
Fluorene	2.80E-06	1.54E-08	6.73E-08
Formaldehyde	7.50E-02	4.12E-04	1.80E-03
Hexane	1.80E+00	9.88E-03	4.33E-02
Indo(1,2,3-cd)pyrene	1.80E-06	9.88E-09	4.33E-08
Phenanthrene	1.70E-05	9.33E-08	4.09E-07
Pyrene	5.00E-06	2.75E-08	1.20E-07
Toluene	3.40E-03	1.87E-05	8.18E-05
Arsenic	2.00E-04	1.10E-06	4.81E-06
Beryllium	1.20E-05	6.59E-08	2.89E-07
Cadmium	1.10E-03	6.04E-06	2.65E-05
Chromium	1.40E-03	7.69E-06	3.37E-05
Cobalt	8.40E-05	4.61E-07	2.02E-06
Lead	5.00E-04	2.75E-06	1.20E-05
Manganese	3.80E-04	2.09E-06	9.14E-06
Mercury	2.60E-04	1.43E-06	6.25E-06
Nickel	2.10E-03	1.15E-05	5.05E-05
Selenium	2.40E-05	1.32E-07	5.77E-07
Polycyclic Organic Matter:			
Methylnaphthalene (2-)	2.40E-05	1.32E-07	5.77E-07
Naphthalene	6.10E-04	3.35E-06	1.47E-05
Total HAP		**1.04E-02**	**4.54E-02**

[a] Emission factors from AP-42 Section 1.4 "Natural Gas Combustion" Tables 1.4-1, 1.4-2, & 1.4-3

[b] NO_x emission factors from vendor guarantee.

[c] Emission Rate (lb/hr) = Rated Capacity (MMscf/hr) × Emission Factor (lb/MMscf) x (Actual Fuel HHV/1020).

[d] Annual Emissions $(tons/yr)_{Potential} = (lb/hr)_{Emissions}$ × (Maximum Allowable Operating Hours, 8760 hr/yr) × (1 ton/2000 lb).

MarkWest Liberty Midstream & Resources L.L.C.
Majorsville Gas Plant

HMO Heater
(H-781)

Source Designation:	
Manufacturer:	Heatec
Year Installed	2011
Fuel Used:	Natural Gas
Higher Heating Value (HHV) (Btu/scf):	1,020
Heat Input (MMBtu/hr)	15.40
Fuel Consumption (mmscf/hr):	1.51E-02
Potential Annual Hours of Operation (hr/yr):	8,760

Criteria and Manufacturer Specific Pollutant Emission Rates

Pollutant	Emission Factor (lb/MMscf)[a,b]	Potential Emissions (lb/hr)[c]	Potential Emissions (tons/yr)[d]
NO_x	88.4	1.335	5.846
CO	84	1.268	5.555
SO_2	0.6	0.009	0.0397
PM Total	7.6	0.115	0.5026
PM Condensable	5.7	0.086	0.377
PM_{10} (Filterable)	1.9	0.029	0.126
$PM_{2.5}$ (Filterable)	1.9	0.029	0.126
VOC	5.5	0.083	0.364

MarkWest Liberty Midstream & Resources L.L.C.
Majorsville Gas Plant

HMO Heater
(H-781)

Hazardous Air Pollutant (HAP) Potential Emissions

Pollutant	Emission Factor (lb/MMscf)[a]	Potential Emissions (lb/hr)[c]	Potential Emissions (tons/yr)[d]
HAPs:			
3-Methylchloranthrene	1.80E-06	2.72E-08	1.19E-07
7,12-Dimethylbenz(a)anthracene	1.60E-05	2.42E-07	1.06E-06
Acenaphthene	1.80E-06	2.72E-08	1.19E-07
Acenaphthylene	1.80E-06	2.72E-08	1.19E-07
Anthracene	2.40E-06	3.62E-08	1.59E-07
Benz(a)anthracene	1.80E-06	2.72E-08	1.19E-07
Benzene	2.10E-03	3.17E-05	1.39E-04
Benzo(a)pyrene	1.20E-06	1.81E-08	7.94E-08
Benzo(b)fluoranthene	1.80E-06	2.72E-08	1.19E-07
Benzo(g,h,i)perylene	1.20E-06	1.81E-08	7.94E-08
Benzo(k)fluoranthene	1.80E-06	2.72E-08	1.19E-07
Chrysene	1.80E-06	2.72E-08	1.19E-07
Dibenzo(a,h) anthracene	1.20E-06	1.81E-08	7.94E-08
Dichlorobenzene	1.20E-03	1.81E-05	7.94E-05
Fluoranthene	3.00E-06	4.53E-08	1.98E-07
Fluorene	2.80E-06	4.23E-08	1.85E-07
Formaldehyde	7.50E-02	1.13E-03	4.96E-03
Hexane	1.80E+00	2.72E-02	1.19E-01
Indo(1,2,3-cd)pyrene	1.80E-06	2.72E-08	1.19E-07
Phenanthrene	1.70E-05	2.57E-07	1.12E-06
Pyrene	5.00E-06	7.55E-08	3.31E-07
Toluene	3.40E-03	5.13E-05	2.25E-04
Arsenic	2.00E-04	3.02E-06	1.32E-05
Beryllium	1.20E-05	1.81E-07	7.94E-07
Cadmium	1.10E-03	1.66E-05	7.27E-05
Chromium	1.40E-03	2.11E-05	9.26E-05
Cobalt	8.40E-05	1.27E-06	5.55E-06
Lead	5.00E-04	7.55E-06	3.31E-05
Manganese	3.80E-04	5.74E-06	2.51E-05
Mercury	2.60E-04	3.93E-06	1.72E-05
Nickel	2.10E-03	3.17E-05	1.39E-04
Selenium	2.40E-05	3.62E-07	1.59E-06
Polycyclic Organic Matter:			
Methylnaphthalene (2-)	2.40E-05	3.62E-07	1.59E-06
Naphthalene	6.10E-04	9.21E-06	4.03E-05
Total HAP		**2.85E-02**	**1.25E-01**

[a] Emission factors from AP-42 Section 1.4 "Natural Gas Combustion" Tables 1.4-1, 1.4-2, & 1.4-3

[b] NO_x emission factors from vendor guarantee.

[c] Emission Rate (lb/hr) = Rated Capacity (MMscf/hr) × Emission Factor (lb/MMscf) x (Actual Fuel HHV/1020).

[d] Annual Emissions $(tons/yr)_{Potential}$ = $(lb/hr)_{Emissions}$ × (Maximum Allowable Operating Hours, 8760 hr/yr) × (1 ton/2000 lb).

MarkWest Liberty Midstream & Resources L.L.C.
Majorsville Gas Plant

Hot Oil Heater
(H-1741 & H-D2741)

Source Designation:	
Manufacturer:	Tulsa Heaters Inc.
Year Installed	TBD
Fuel Used:	Natural Gas
Higher Heating Value (HHV) (Btu/scf):	1,020
Heat Input (MMBtu/hr)	14.25
Fuel Consumption (mmscf/hr):	1.40E-02
Potential Annual Hours of Operation (hr/yr):	8,760

Criteria and Manufacturer Specific Pollutant Emission Rates

Pollutant	**Emission Factor (lb/MMscf)[a,b]**	**Potential Emissions (lb/hr)[c]**	**(tons/yr)[d]**
NO_x	40.8	0.570	2.497
CO	41.82	0.584	2.559
SO_2	0.6	0.008	0.0367
PM Total	13.26	0.185	0.8114
PM Condensable	5.7	0.080	0.349
PM_{10} (Filterable)	1.9	0.027	0.116
$PM_{2.5}$ (Filterable)	1.9	0.027	0.116
VOC	19.38	0.271	1.186

MarkWest Liberty Midstream & Resources L.L.C.
Majorsville Gas Plant

Hot Oil Heater
(H-1741 & H-D2741)

Hazardous Air Pollutant (HAP) Potential Emissions

Pollutant	Emission Factor (lb/MMscf)[a]	Potential Emissions (lb/hr)[c]	Potential Emissions (tons/yr)[d]
HAPs:			
3-Methylchloranthrene	1.80E-06	2.51E-08	1.10E-07
7,12-Dimethylbenz(a)anthracene	1.60E-05	2.24E-07	9.79E-07
Acenaphthene	1.80E-06	2.51E-08	1.10E-07
Acenaphthylene	1.80E-06	2.51E-08	1.10E-07
Anthracene	2.40E-06	3.35E-08	1.47E-07
Benz(a)anthracene	1.80E-06	2.51E-08	1.10E-07
Benzene	2.10E-03	2.93E-05	1.29E-04
Benzo(a)pyrene	1.20E-06	1.68E-08	7.34E-08
Benzo(b)fluoranthene	1.80E-06	2.51E-08	1.10E-07
Benzo(g,h,i)perylene	1.20E-06	1.68E-08	7.34E-08
Benzo(k)fluoranthene	1.80E-06	2.51E-08	1.10E-07
Chrysene	1.80E-06	2.51E-08	1.10E-07
Dibenzo(a,h) anthracene	1.20E-06	1.68E-08	7.34E-08
Dichlorobenzene	1.20E-03	1.68E-05	7.34E-05
Fluoranthene	3.00E-06	4.19E-08	1.84E-07
Fluorene	2.80E-06	3.91E-08	1.71E-07
Formaldehyde	7.50E-02	1.05E-03	4.59E-03
Hexane	1.80E+00	2.51E-02	1.10E-01
Indo(1,2,3-cd)pyrene	1.80E-06	2.51E-08	1.10E-07
Phenanthrene	1.70E-05	2.38E-07	1.04E-06
Pyrene	5.00E-06	6.99E-08	3.06E-07
Toluene	3.40E-03	4.75E-05	2.08E-04
Arsenic	2.00E-04	2.79E-06	1.22E-05
Beryllium	1.20E-05	1.68E-07	7.34E-07
Cadmium	1.10E-03	1.54E-05	6.73E-05
Chromium	1.40E-03	1.96E-05	8.57E-05
Cobalt	8.40E-05	1.17E-06	5.14E-06
Lead	5.00E-04	6.99E-06	3.06E-05
Manganese	3.80E-04	5.31E-06	2.33E-05
Mercury	2.60E-04	3.63E-06	1.59E-05
Nickel	2.10E-03	2.93E-05	1.29E-04
Selenium	2.40E-05	3.35E-07	1.47E-06
Polycyclic Organic Matter:			
Methylnaphthalene (2-)	2.40E-05	3.35E-07	1.47E-06
Naphthalene	6.10E-04	8.52E-06	3.73E-05
Total HAP		**2.64E-02**	**1.16E-01**

[a] Emission factors from AP-42 Section 1.4 "Natural Gas Combustion" Tables 1.4-1, 1.4-2, & 1.4-3

[b] NO_x, CO, Pmtotal, and VOC emission factors from vendor guarantee.

[c] Emission Rate (lb/hr) = Rated Capacity (MMscf/hr) × Emission Factor (lb/MMscf) x (Actual Fuel HHV/1020).

[d] Annual Emissions $(tons/yr)_{Potential}$ = $(lb/hr)_{Emissions}$ × (Maximum Allowable Operating Hours, 8760 hr/yr) × (1 ton/2000 lb).

H-781

THOMAS RUSSELL CO.

Tulsa, Oklahoma

JOB NO: TRJ-207 DATE: 8/4/2008
CLIENT: Chesapeake Energy BY: AHO
SUBJECT: 120 MMCFD Cryo Plant

FIRED HEATER

Service:	HMO Heater			Tag No:	H-781
Design Duty, MBTU/Hr	11,760			Type:	Helical Coil
No. of Coils per Unit	One	No. Units:	One	Model:	Heatec HCI-8010-50-G

Fluid		Therminol 62		Burners		
		Inlet	Outlet		Gas	Oil
Liquids	Lbs/Hr	187,202	187,202	LHV (BTU/cf)	1013	
Density	Lbs/CuFt	56.55	53.45	Mol. Wt.	18.24	
Molecular Weight		252	252	Gravity		
Specific Heat	BTU/Lb °F	0.506	0.541	Pressure Avail. (psig)	100	
Thermal Cond.	BTU/Hr-Ft-°F	0.0676	0.0640	Pressure Req'd (psig)		
Viscosity	cP	2.865	1.001	Steam for Atomizing		
Vapor	Lbs/Hr	0	0	Fuel Gas Req'd (MSCFD)	287.0	N/A
Density	Lbs/CuFt			Mfgr:	Eclipse Ratiomatic 2000	
Molecular Weight				Type:	Forced Draft - 20 Hp Blower	
Specific Heat	BTU/Lb °F			Number Req'd	One	
Thermal Cond.	BTU/HrFt °F			Pilots Req'd	Yes, electric ignition	
Viscosity	cP			Nox	< 65 ppmvd	
Operating Temp.	°F	190	310	**Structural Design**		
Operating Pressure	PSIA	75	55	Wind Load, MPH, (3)		
Velocity	Ft/Sec	Allow.	Calc.	Seismic Zone, (3)		
Pressure Drop	PSI	20 Allow.	Calc.	Ambient, °F	-20 / 110	
Fouling Resistance	SqFt*F/BTU	0.002		Elevation, Ft	3000	
Design Press. / Temp.		150 PSIG	400 °F	**Stack Design**		
Min. Design Mtl. Temp.		-20 °F @	150 PSIG	Self-supporting	Yes	
Corrosion Allowance		0.0625		Minimum Height	8 ft above top of heater	
Insulation Thickness		3" - 5" Ceramic Fiber on Interior		Minimum Wall Thickness:	0.125	
Efficiency-Based on LHV	(%)	84.0%	(Assume 3% Loss)	Lining Type	No	
Excess Air		15%		Lining Thickness:	No	
Firebox Unit Heat Release		25,300	BTU/Hr- Ft^3	Damper:	No	
Number of Passes		One - process, Two -fireside				

Coil Design		Radiant	Convection-Bare	Convection-Finned	
Gas Temperature	In/Out	190 / 310			
Number Tubes		One			
Tube O.D.	In	5" Sch. 40	5"300# ANSI RFWN Flg.	Inlet and Outlet	
Tube Length	Eff. Ft	----			
Bare Surface	Sq Ft	1,130			
Finned Surface	Sq Ft	N/A			
Avg. Heat Flux	BTU/Hr-Sq Ft	13,241			
Tube Materials		SA- 106 Gr. B	SA-	SA-	

Convection Fins (inch):	Height:	Thickness:	No. / inch:	Material:	
Overall Dimension:	29' - 2" L x 8' - 9" W x 10' - 0" H (less stack)			28,300 lbs dry weight	
Code Requirements:	ASME VIII Div I		Stamp: Yes	Nat'l Board:	Yes

Notes: 1)

2) See attached Scope of Supply.
3) Wind design per ASCE 7-05, I=1.15, Exposure C. Seismic design per ASCE 7-05, I=1.25, Site D, S_s=100%, S_1=40%.
4) Electrical power to be 480 v / 3 ph / 60 hz. Control enclosures to be NEMA 4.
5) Add spare ignitor.

REVISION	A	0	1	
ENGINEER/DATE	AHO | 8/4/08	DDO | 9/3/08	JRG | 11/12/09	
ISSUED FOR	RFQ	Purchase	Check Rate	

H- 1731 + H -1791

1. INTRODUCTION

1.1 Executive Summary

On behalf of the entire TULSA HEATERS INC. (THI) organization, it is my pleasure to present THI's proposal for One Direct Fired Heater for MarkWest Energy in response to TRCo RfQ J-287.

In accordance with the aforementioned inquiry, THI's proposal provides the following:

Process Summary:
- *the inquiry specified heater type (Standard HOrizontal (SHO) Heater)*
- *the inquiry specified design duty (10.15 MMBTU/ hr)*
- *the inquiry specified thermal efficiency (85.8% Calculated)*

Combustion Summary:
- *the inquiry specified burner type (CUBL, FreeJet or COOLstar)*
- *the inquiry specified NOx Emissions (not to exceed 30 ppm)*

Mechanical Summary:
- *the inquiry specified coil materials (tubes of SA106 Gr.B)*
- *the inquiry specified internal coating, as noted below (None)*
- *the inquiry specified casing and structure (Basic Velocity = 90 mph)*
- *the inquiry specified external coating, as noted below (3.0- 4.0 dftmil Gray CZ11 Primer on SP-6 Surface)*
- *the inquiry specified refractory systems (ie, castables & c.f. blanket systems)*
- *one THI specified lined stack (reference data sheets for details)*

Additional design and scope of supply details are provided in Sections 2, 3, 4, 5, 6, 7, and 8.

2. BASIS of PROPOSAL

2.1 Applicable Documents

2.1.1 THI's Design Standards

Unless superseded by the Customer's inquiry specifications, THI's proposal is based on the application of ISO 13705 / API Std560 and the following industry standards to the extent that they apply to general service fired heaters and waste heat recovery modules.

• API	Std 530, Std 560, RP 531M, RP 535, RP536 RP 550 and RP 556
• AISC	Manual of Steel Construction
• ANSI/ASCE	7-02
• ASME	B16.5, B16.9, B16.11, B31.1, B31.3, B36.10, Boiler & Pressure Vessel Code, Sections I through IX
• ASTM	A193, A194, A-297, A-351, A384, A385, C64, C155, C332, E186,
• CSA	B51
• ICBO	Uniform Building Code
• ISO	13704 & 13705
• CNBC	Canadian National Building Code

2.1.2 THI's Manufacturing Standards

Unless superseded by the Customer's inquiry specifications, THI's proposal is based on the application of ISO 13705 / API Std560 and the following industry standards to the extent that they apply to general service fired heaters and waste heat recovery modules.

• ASTM	Tubes*: A53, A106, A161, A200, A213, A271, A312, A333, A335, A376, A608, B163, B167, B407 and B423
	* All heater tubes will be seamless, unless such tubulars are not commercially available (and same will be ERW w/ 100% RT).
	Fittings: A216, A217, A234, A351, A403, A420, B366
	Forgings A105, A182, A350, B564
	Supports A216, A217, A240, A283, A297, A447, A560, E165, E433, E446
	Refracto C27, C155, C401, C612
	L&P's: A36, A123, A143, A153, A384, A385, A572, A588, A786
	Casing: A36, A514, A529, A572, A852
	Stiffners A36, A242, A529, A572, A588, A852, A913
	Structure A36, A242, A529, A572, A588, A913, A992
• AWS	D1.1 Structural Welding Code
• CSA	W47.1, W59
• SSPC	SP-3, SP-5, SP-6, SP-10

2.1.3 Inquiry Documents

This proposal is rigorously based on TRCo RfQ J-287 and all of its attachments (note the enclosed document listing: LIST 2.1). Furthermore, except as superseded by the inquiry specifications, THI's proposal is in accordance with the following industrial standards.

3. SCOPE of SUPPLY

3.1 Activities

This proposal provides for the following major activities:

- *Process Design (combustion + thermal + hydraulic + draft),*
- *Mechanical Design (coil wall + terminal loads + refractory),*
- *Structural Design (with RISA),*
- *Project Management,*
- *General Arrangement Drawings and Documentation,*
- *Fabrication (Detail) Drawings and Documentation,*
- *Component & Materials Procurement,*
- *Shop Fabrication and Module Assembly,*
- *Expediting,*
- *Quality Assurance/Quality Control,*
- *Document Control,*
- *Shipping Preparation,*
- *Shipping to Site/Port (optional),*
- *Site Supervision (optional), and*
- *Commissioning and Start-up (optional).*

3.2 Materials & Services

Please refer to TABLE 3.2 for definition of THI 's proposed materials and services scope of supply (ie, our understanding of the inquiry's requirements). Furthermore, realizing that the proposed custom engineered heater has not been fully integrated into the Customer 's process unit design, THI offers to provide future material and engineering changes as set forth in section 8.3. Please refer to subsection 8.3 for details.

3.3 Documentation

The above activities will typically yield the following relevant documentation:

- *Data Sheets; fired heaters, burners, fans, etc.,*
- *Calculations; draft, settings, coil wall, stack frequency, structural, etc.*
- *Performance Curves; burners, fans, etc.,*
- *General Arrangement Drawings; casing, structure, refractory, coil, components,*
- *Foundation Loading Diagram; wind, seismic, snow and load combinations,*
- *Fabrication Drawings; all fabricated components except coil,*
- *Procedures; performance test, NDE, welding, PWHT, and erection procedures,*
- *Final Data Books; collection of all historically important data, and*
- *Test and NDE Records.*

Please refer to TABLE 3.3 for a complete definition of THI 's proposed documentation scope of supply (ie, our understanding of your vendor data requirements).

6. TECHNICAL

6.1 Overview of Regen Gas Heater - H-1741 ; THI's P12-8006

6.1.1 Technical Discussion

The proposed heater is a Standard HOrizontal (SHO) box type with a helical coil that satisfies the inquiry document requirements. In accordance with these documents, THI's base offer for this heater provides the following performance and features:

Process Design

- *Total process duty of 10.16 MMBTU/hr during Design operations,*
- *Single Fired Radiant Coil features 2D spacing and provides 700 ft2 surface area,*
- *Process pressure drop of 10 psig for Design operations,*
- *Calculated thermal efficiency of 85.8% during Design operations,*

Combustion Design

- *Burner Management System (BMS) consisting of Gas and Pilot Trains, and a Local Control Panel designed for Class I, Division 2 areas.*
- *FD Gas Fired Burner (w/ Pilot and FD Fan) that provides 3.17:1 firing turndown,*
- *FD Fan Assembly, with El.Motor and Control Damper (shop installed at FabShop),*
- *Fuel Gas and Pilot Gas Trains per NFPA 87 (shop installed at FabShop),*
- *Local Panel in enclosure suitable for outdoor service (ship loose for Field installation),*

Mechanical Design

- *Overall mechanical design is in substantial compliance with API Std 560 / ISO 13705,*
- *Process Coils' thermal design is per API Standard 530 / ISO 13704,*
- *Process Coils's mechanical design is per ASME Section VIII,*
- *Process Coil Supports are API Standard 560 / ISO 13705 compliant,*
- *Radiant casing of stiffened 10 ga CS plate; per data sheets & TABLE 3.2,*
- *Radiant structure of typical CS shapes; per data sheets & TABLE 3.2,*
- *Convection casing of stiffened 10 ga CS plate; per data sheets & TABLE 3.2,*
- *Convection tubesheets of 3/8 in CS plate; per data sheets & TABLE 3.2,*
- *Convection structure of typical CS shapes; per data sheets & TABLE 3.2,*
- *Exhaust Duct (stub-stack) of 10 ga CS plate; per data sheets & TABLE 3.2,*
- *External coating(s) are 3.0- 4.0 dftmil CZ11 Primer; per data sheets & TABLE 3.2,*
- *Internal coating is NOT included; per data sheets & TABLE 3.2,*

6.1.2 Fired Heater Data Sheets; Single Cell Standard HOrizontal (SHO) type

6.1.3 Sketch; Single Cell Standard HOrizontal (SHO) Elevation

Owner:	MarkWest Energy	Owner Ref.:	H-1741		Pm
Purchaser:	THOMAS RUSSELL CO.	Purchaser Ref.:	J-267		4
Manufacturer:	TULSA HEATERS INC.	THI Ref.:	P12-8008	/ SHO1250.LP 16x 10.5	Rev
Service:	Regen Gas	Unit No:	Utility		
Number:	One	Location:	PlantSite Unknown		
Process Duty:	10.16 MMBTU/ hr	Heater Type:	Standard HOrizontal (SHO) Heater w/ High Efficiency Convection Section and Forced Draft Combustion System		
Total Duty:	10.16 MMBTU/ hr				

PROCESS DESIGN CONDITIONS

Heater Section	---	RADIANT	CONVECTION	CONVECTION	TOTAL
Operating Case	---	Design Case	Design Case	Design Case	Design Case
Service	---	Regen Gas	Regen Gas	Service "b"	
Heat Absorption	MMBTU/ hr	7.14	3.01 / 9.15	0.00	10.15
Process Fluid	---	HC Vapour	HC Vapour		
Process Mass Flow Rate, Total	Lb/ hr	32,400	32,400		
Process Bulk Velocity (allow. / calc.)	ft/ s	--- / 46	--- / 11	/	
Process Mass Velocity (min./ calc.)	Lb/ s ft2	--- / 88	--- / 61	/	
Coking Allowance (dP calcs)	in				
Pressure Drop, Clean (allow. / calc.)	psi	<------ 10 / 10	------>	/	
Pressure Drop, Fouled (allow. / calc.)	psi	<------ /	------>	/	
Average Heat Flux (allowable)	BTU/ hr ft2	12,000			
Average Heat Flux (calculated)	BTU/ hr ft2	10,200			
Maximum Heat Flux (allowable)	BTU/ hr ft2				
Maximum Heat Flux (calculated)	BTU/ hr ft2	18,360	16,000		
Fouling Factor, Internal	hr ft2 °F/ BTU	0.001	0.001		
Corrosion or Erosion Characteristics	---				
Max. Film Temperature (allow. / calc.)	°F	/ 625	/ 391	/	
Inlet Conditions:					
Temperature	°F	256	132		
Pressure	psig	674	676		
Mass Flow Rate, Liquid	Lb/ hr		0		
Mass Flow Rate, Vapor	Lb/ hr		32,400		
Weight Percent, Liquid / Vapor	wt%		0% / 100%	/	
Density, Liquid / Vapor	Lb/ ft3		0.00 / 4.69	/	
Molecular Weight, Liquid / Vapor	Lb/ Lbmole		/ 29.8	/	
Viscosity, Liquid / Vapor	cp		0.000 / 0.013	/	
Specific Heat, Liquid / Vapor	BTU/ Lb °F		0.000 / 0.695	/	
Thermal Conductivity, Liquid/Vapor	BTU/hr ft °F		0.000 / 0.018	/	
Surface Tension, Liquid	dyne/ cm		/	/	
Outlet Conditions:					
Temperature	°F	560✓	256		
Pressure	psig	665	674		
Mass Flow Rate, Liquid	Lb/ hr	0			
Mass Flow Rate, Vapor	Lb/ hr	32,400			
Weight Percent, Liquid / Vapor	wt%	0% / 100%		/	
Density, Liquid / Vapor	Lb/ ft3	0.00 / 1.91		/	
Molecular Weight, Liquid / Vapor	Lb/ Lbmole	/ 29.8		/	
Viscosity, Liquid / Vapor	cp	0.000 / 0.018		/	
Specific Heat, Liquid / Vapor	BTU/ Lb °F	0.000 / 0.702		/	
Thermal Conductivity, Liquid/Vapor	BTU/hr ft °F	0.000 / 0.035		/	
Surface Tension, Liquid	dyne/ cm	/		/	

Rev.00	1-Feb-12	Issued w/ Initial Proposal	JEH	COX	VPS
revision	date	description	by	chkd	apprv'd

Owner Ref.: H-1741 THI Ref.: P12-8006

Pin & Rev

COMBUSTION DESIGN CONDITIONS

Overall Performance:		RADIANT	CONVECTION	CONVECTION	TOTAL
Operating Case	---	Design Case	Design Case	Design Case	Design Case
Service	---	Regen Gas	Regen Gas	Service "b"	
Excess Air	mol%				15.0%
Calculated Heat Release (LHV)	MMBTU/hr				11.83
Guaranteed Efficiency	HR%				89.0%
Calculated Efficiency	HR%				85.8%
Radiation Loss	HR%				1.50%
Flow Rate, Combustion Gen./ Imported	Lb/ hr	11,586	/ 0		11,586
Flue Gas Temperature Leaving Section	°F	1,410	890		
Flue Gas Mass Velocity	Lb/ sec ft2		0.278		

Fuel(s) Data:		Design Mol.Wt.			Design Fuel Oil
LHV	BTU/ scf	884			---
LHV	BTU/ Lb	19,295			
P @ Burner	psig	30			
T @ Burner	°F	100			
MW	Lb/ Lbmole	17.39			
μ @ ??? °F	cp	---			
μ @ ??? °F	cp	---			
Atomizing Media		---			
Atom. Media P & T		---			

Components:					
N	wt%	---			
S	wt%	---			
Ash	wt%	---			
Ni	ppm	---			
Va	ppm	---			
Na	ppm	---			
Fe	ppm	---			
H2	mol%	0.00			---
O2	mol%	0.00			---
N2 + Ar	mol%	0.20			---
CO	mol%	0.00			---
CO2	mol%	3.80			---
CH4	mol%	84.25			---
C2H6	mol%	1.40			---
C2H4	mol%	0.00			---
C3H8	mol%	0.14			---
C3H6	mol%	0.00			---
C4H10	mol%	0.04			---
C4H8	mol%	0.00			---
C5H12	mol%	0.00			---
C5H10	mol%	0.00			---
C6+	mol%	0.00			---
H2S	mol%	0.05			---
SO2	mol%	0.00			---
NH3	mol%	0.00			---
H2O	mol%	0.07			---
spare	mol%	0.00			---

Nominal Clearances:		Vertical	Horizontal
... for Gas Firing:		Calculated	Calculated
... from burner CL ...		per THI Design	per THI Design
to Tube CL	ft	3.44	3.44
to Refractory	ft	n/a	19.10

Burner Design:

OEM	---	Callidus, ZEECO or John Zink
Type	---	ULTRA Low NOx 4th Gen Low NOx
Quantities	---	3 Model 1 and 0 Model 2 Burners
Model No.1	---	CUBL, FreeJet or COOLstar Cylindrical
Model No.2	---	None
Windbox	---	yes ... w/ parallel blade registers
Location	---	EndWall Center ... Horizontally Fired

Pilot Design:

Type	---	Continuous Self-inspirating
Model	---	by O.E.M.
Ignition	---	Electric requires elec.ign.system
Heat Release	---	> 90,000 BTU/hr on ... Design RFG

Burner Performance:		Model 1	Model 2
Minimum Heat Release	MMBTU/ hr	1.50	
Design Heat Release	MMBTU/ hr	3.94	
Maximum Heat Release	MMBTU/ hr	4.75	
Burner Turndown	Max:Min	3.17	
Volumetric Ht. Release	BTU/ hr ft3	10,230	
Draft @ Arch	inH2O	0.10	
Draft @ Burner	inH2O	5.70	
Combustion Air T @ Burner	°F	80	
Flue Gas T @ Burner	°F	1,410	

Guaranteed Emissions:		<-- Combined -->	
Basis of Guarantee	---	3.0% O2, dry (LHV)	
NOx Emissions	Lb/MMBTU	0.040	30 ppm
SOx Emissions	Lb/MMBTU	no quote	no quote
CO Emissions	Lb/MMBTU	0.041	50 ppm
UHC Emissions	Lb/MMBTU	0.007	15 ppm
VOC Emissions	Lb/MMBTU	0.015	15 ppm
SPM10 Emissions	Lb/MMBTU	0.013	15 ppm
Noise Emissions	dBA @ 3ft	85.0	------ >

Special Burner Features &/ or Services:

Reed Wall	None - - not applicable
Pilot Detection	None
Main Detection	None
Burner Test	Yes; per Attachment A
CFD/ CF Models	None / None

Net Clearances:

Est. Flame Size	approx. 12 ft. x 2 ftDia
Hor Clearance	2' 3" NET Tube Clearance
Vert. Clearance	2' 3" NET Tube Clearance
Axial Clearance	4 ft NET Refractory Clearance (ie, Arch hot face)

Owner Ref.: H-1741 T-U Ref.: P12-6006

PRESSURE PARTS DESIGN

								Fint & Rev
Coil Design:			RADIANT		SHIELD	CONVECTION	CONVECTION	
Service		---	Regen Gas		Regen Gas	Regen Gas	Service "D"	
Design Basis for Tube Temperature		---	ISO 13704 (530)		ISO 13704 (530)	ISO 13704 (530)		
Design Basis for Tube Wall Thickness		---	ASME Section VIII		ASME Section VIII	ASME Section VIII		
Design Life		hr	100,000		100,000	100,000		
Design Pressure (elastic / rupture)		psig	800 /		800 /	800 /		
Design Fluid Temperature		°F	575		281	281		
Design Temperature Allowance		°F	25		25	25		
Design Corrosion Allowance (tubes/fittin		in	0.063 / 0.063		0.063 / 0.063	0.063 / 0.063	/	
Maximum Tube Temperature (clean)		°F	639					
Maximum Tube Temperature (fouled)		°F	660		409	409		
Design Tube Temperature		°F	710		461	461		
Inside Film Coefficient	BTU/ hr ft2 °F		275		132	132		
Weld Inspection	RT or Other		100 of 100%		100 of 100%	100 of 100%		
Weld Heat Treatment	s.rel., t.stab. or none		None		None	None		
Hydrostatic Test Pressure	psig		per API		per API	per API		
Coil Arrangement:			Horizontal		Horizontal	Horizontal		
Coil Type		---	Helical		Serpentine	Serpentine		
Tube Material (pipe or tube spec)		ASTM	SA106 Gr.B		SA106 Gr.B	SA106 Gr.B		
Supplementary Mfg Requirements		ASTM	None		None	None		
Tube Outside Diameter		in	3.500		4.500	4.500		
Tube Wall Thickness (aw / mw)		in	0.216 / 0.185		0.237 / 0.207	0.237 / 0.207	/	
Number of Cells (radiant or convection)		---	1		1	1		
Number of Flow Passes (total / cell)		---	2 / 2		2 / 2	2 / 2	/	
Number of Tubes per Row (total / cell)		---			4 / 4	4 / 4	/	
Overall Tube (1 turn in radiant) Length		ft	28.28		11.50	11.50		
Effective Tube Length / Helix Diameter		ft	28.28 / 9.00		9.92	9.92		
Number of Turns or Tubes (total / pass)		---	27.0 / 13.5		4 / 4	0 / 0	/	
Total Exposed Surface		ft2	700		47	0		
Number of Ext.Surf. Tubes (total / cell)		---	0 / 0		0 / 0	12 / 12	/	
Total Exposed Surface		ft2	0		0	1,512		
Tube Spacing (horizontal / tube centers)		in	--- / 8.00		8.00 / 8.00	8.00 / 8.00	/	
Tube Spacing (horizontal to refractory)		in	4.50		4.00	4.00		
Coil Fittings:			Regen Gas		Regen Gas	Regen Gas		
Fitting Type		---	SR 180° U-Bends		SR 180° U-Bends	SR 180° U-Bends		
Fitting Material		ASTM	A234 WPB		A234 WPB	A234 WPB		
Supplementary Mfg Requirements		ASTM	None		None	None		
Fitting Outside Diameter		in	3.500		4.500	4.500		
Fitting Wall Thickness (aw / mw)		in	0.216 / 0.185		0.237 / 0.207	0.237 / 0.207	/	
Fitting Location	inismal or external		Inismal		External	External		
Tube Attachment	welded or rolled		Welded		Welded	Welded		
Coil Terminals:			Outlet			Inlet		
Terminal Type	beveled or flanged		Flanged			Flanged		
Flange Material		ASTM	A105			A105		
Supplementary Mfg Requirements		ASTM	None			None		
Flange Size and Rating		NPS/ ASME	3" NPS / 300 #			4" NPS / 300 #		
Flange Type		RFWN or RTJ	RFWN			RFWN		
Location		---	Burner Endwall			Terminal End		
Extended Surface:					CONVECTION	CONVECTION	CONVECTION	
Service		---			Regen Gas	Regen Gas	Future	
Fin or Stud Row Number	starting @ bottom				No.1 / No.2	No.3 /	None /	
Ext. Surface Type	seg.fins, solid fins, studs				HF Seg. Fins	HF Seg. Fins		
Fin/Stud Material		---			C.S. / C.S.	C.S. /	/	
Fin/Stud Dimensions	H x T, in				1.00 x 0.080"	1.00 x 0.080"		
Fin/Stud Density	fin/ in or stud/ plane				2.00 fpi / 3.00 fpi	4.00 fpi /	/	
Maximum Fin/Stud Temperature		°F			600 / 740	650 /	/	

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Fin & Rev

PRESSURE PARTS DESIGN (continued)

			RADIANT	SHIELD	CONVECTION	CONVECTION
Crossovers:						
Type, location / connections	---		External	/ Flanged	None	
Tube / Fittings Material	ASTM		SA106 Gr.B	/ A234 WPB		
Tube & Fitting OD / Thickness (aw)	in		3.500	/ 0.216		
Inlet Manifold(s):	type				Simple LOG	
Location	---				Top of Convection	
Pipe Material	ASTM				SA106 Gr.B	
Fittings Material	ASTM				A234 WPB	
Design Basis for Manifold Thickness	---				ASME B31.3	
Design Conditions (temp./press.)	°F/ psig				281 / 800.0	
Outside Diameters, each Branch	in				8" NPS	
Wall Thickness(es); aw or mw	in				sch40 (0.322"aw)	
Tube Connection Type	extrusion, olet, etc.				Weld-O-Let	
End Types (terminal/ dead)	beveled or flanged				Flanged / W.Cap	
Terminal Flange Material	ASTM				A105	
Terminal Flange Size and Rating	NPS/ ASME				8"NPS / 300#	
Terminal Flange Style	RFWN or RTJ				RFWN	
Outlet Manifold(s):	type		Simple LOG			
Location	---		Burner Endwall			
Pipe Material	ASTM		SA106 Gr.B			
Fittings Material	ASTM		A234 WPB			
Design Basis for Manifold Thickness	---		ASME B31.3			
Design Conditions (temp./press.)	°F/ psig		576 / 800.0			
Outside Diameters, each Branch	in		8" NPS			
Wall Thickness(es); aw or mw	in		sch40 (0.322"aw)			
Tube Connection Type	extrusion, olet, etc.		Weld-O-Let			
End Types (terminal/ dead)	beveled or flanged		Flanged / W.Cap			
Terminal Flange Material	ASTM		A105			
Terminal Flange Size and Rating	NPS/ ASME		8"NPS/ 300#			
Terminal Flange Style	RFWN or RTJ		RFWN			

COIL & MANIFOLD SUPPORTS DESIGN

			RADIANT	SHIELD	CONVECTION	CONVECTION
Tube Supports:						
Service	---		Regen Gas	Regen Gas	Regen Gas	Service "D"
Location	Top, Bottom, Ends		Bottom	Ends	Ends	
Support Type	casting, tubesht, spring, etc.		HD Angles	Welded Tbsheets	Welded Tbsheets	
Support Thicknesses	in		2 x 2 x 0.250	0.375	0.375	
Support Materials	ASTM		A240 T304H	A36 CS	A36 CS	
Support Temperatures (calc./ design)	°F / °F		1,010 / 1,210	545 / 700	545 / 700	/
TbSht Ferrules Thickness / Materials	in/ ASTM		--- / ---	14 ga. / 304 SS	14 ga. / 304 SS	/
Refractory & Anchor Materials & Types	---		none	per refrac. section	per refrac. section	
Intermediate Guides & Supports:			One	None	None	
Location	---		Top			
Guide/ Support Type	casting, spring, etc.		HD Angles			
Material	ASTM		A240 T304H			
Spacing, average	ft					
Tube Guides:	Top, Bottom, Ends		None	None	None	
Material	ASTM					
Manifold Supports:			Outlet Manifold		Intlet Manifold	
Material	ASTM		A36		A36	
Materials Design & Supply	---		by THI		by THI	
Location	Top, Bottom, Ends		Burner Endwall		Top of Convection	
Support Type	roller, shoe, spring, etc.		Simple Shelf		Simple Shelf	
Number of Supports	---		One (1)		One (1)	

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Pin & Rev

CASING / REFRACTORY SYSTEMS DESIGN

Radiant Section Design:		BURNER ENDWALL	BURNER FIREWALL	SHIELDED SIDEWALLS	ARCH ENDWALL
Total Refractory Thickness	in	6.0	6.0	9.0	6.0
Hot Face Temperature (design)	°F	2,000°	2,600°	2,000°	2,000°
Hot Face Temperaure (calculated)	°F	1,410	1,610	1,010	1,410
Hot Face Layer	in/---	1/8# CF Blanket	1/8# Cerachem	1/8# CF Blanket	1/8# CF Blanket
Back-Up Layer No.1	in/---	1/8# CF Blanket	2/8# CF Blanket	2/6# CF Blanket	1/8# CF Blanket
Back-Up Layer No.2	in/---	3/6# CF Blanket	3/6# CF Blanket	None	3/6# CF Blanket
Foil Vapor Barrier	in/---	None	None	None	None
Castable Reinforcement (SS Needles)	wt%	None	None	None	None
Anchors / Tie Backs:	---	Pins & Clips	Pins & Clips	Pins & Clips	Pins & Clips
Material	---	310 S.S.	310 S.S.	304 S.S.	310 S.S.
Attachment	---	Welded	Welded	Welded	Welded
Casing:					
Material	in/ASTM	10 ga./ A36	10 ga./ A36	10 ga./ A36	10 ga./ A36
Internal Coating	---	None	None	None	None
External Temperature, Typical	°F	180	135	180	180
Comments / Clarifications	---	w/ clb wraps	24 in Perimeter	w/o clb wraps	w/ clb wraps
		SHOP Installed	SHOP Installed	SHOP Installed	SHOP Installed

		SIDEWALLS		ENDWALLS	
Convection Section Design:		SHIELD	FINNED	TUBESHEETS	HEADER BOXES
Total Refractory Thickness	in	3.0	3.0	3.0	2.0
Hot Face Temperature (design)	°F	2,000°	2,000°	2,200°	2,000°
Hot Face Temperaure (calculated)	°F	970	970	970	458
Hot Face Layer	in/---	1/8# CF Blanket	1/8# CF Blanket	3/ Kaolite 2200	1/8# CF Blanket
Back-Up Layer No.1	in/---	2/6# CF Blanket	2/6# CF Blanket	None	1/8# CF Blanket
Back-Up Layer No.2	in/---	None	None		
Foil Vapor Barrier	in/---	None	None	None	None
Castable Reinforcement (SS Needles)	wt%	None	None	None	None
Anchors / Tie Backs:	---	Pins & Clips	Pins & Clips	Bullhorns	Pins & Clips
Material	---	310 S.S.	304 S.S.	304 S.S.	304 S.S.
Attachment	---	Welded	Welded	Welded	Welded
Casing:					
Material	in/ASTM	10 ga./ A36	10 ga./ A36		10 ga./ A36
Internal Coating	---	None	None	None	None
Exdernal Temperature, Typical	°F	180	180		180
Comments / Clarifications	---	Cleaning / Sootblowing lanes: none at 0' - 0" height.			Bolted Assembly
	---	SHOP Installed	SHOP Installed	SHOP Installed	SHOP Installed

		FLUE GAS DUCTS			
Stack & Uptakes Design:		BREECHING	15° TRANSITION	DISCH. DUCT	
Quantity		One	One	One	
Type / Location	---	Full L / Conv	Full L / Conv	Sell.Spl/ Grade	
Length / Metal Outside Diameter (top)	ft/ft	10.50 / n/a	10.50 / n/a	7 / 2.00	
Discharge Elev., minimum/ calculated	ft/ft	n/a / n/a	n/a / n/a	20 / 23	
Total Refractory Thickness	in	1.0	0.0	0.0	
Hot Face Temperature (design)	°F	2,000°			
Hot Face Temperaure (calculated)	°F	0	0	0	
Hot Face Layer	in/---	1/8# CF Blanket	None	None	
Back-Up Layer No.1	in/---	None			
Castable Reinforcement (SS Needles)		None			
Anchors / Tie Backs:	---	Pins & Clips			
Material	---	304 S.S.			
Attachment	---	Welded			
Casing:					
Minimum Thickness/ Material	in/ASTM	10 ga./ A36	0.1875 / A36	0.1875 / A36	
Corrosion Allowance	in	None	None	0.0625	
Internal Coating	---	None	None	None	
External Temperature, Typical	°F	180	0	0	
Comments / Clarifications	---	SHOP Installed			

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Owner Ref.: H-1741 TH Ref.: P12-8006

MECHANICAL / STRUCTURAL DESIGN BASIS

Refractory & Coatings Design:

Refractory Design	180°F Casing / 185°F Floor Temperatures w/ Ambient Conditions of 0 MPH & 80°F
Refractory Dryout	SHOP dryout = None // FIELD dryout (per ES -1-9) within 3 months of shipment is recommended.
Coating, Internal	None
Coating, External	3.0- 4.0 dft/mil Gray Carbozinc 11 Primer on SP-6 Surface (Continuous Service up to 750 °F / 400 °C)
	Complementary Intermediate &/or Finish Coats are OPTIONAL (ie, provided only upon request)

Applicable Standards:

API	~~Std 560 (ISO 13705): Fired Heaters for ...~~	AISC	Specification for Design, ... Steel for Buildings
API	Std 530 (ISO 13704): Calc. of Heater Tube	AWS	D 1.1: Structural Welding Code
ASME	B31.3, Chemical Plant and ... Piping	ASTM	tube/ smls pipe/ fitting spec's noted herein
ASME	Sections I, II, VIII: B&PV Code	ASTM	refractories per C27, C155, C401 & C612
ASME	Section V: Non Destructive Examination	NFPA	NFPA 70: National Electrical Code

Wind Design:

Spec. or Standard	ASCE 7 -10
Velocity/ Imp. Factor	90 mph / 1.15
Site Exposure	"C"

Physical Design:

Plot Limitations	None
Tube Limitations	None
Firebox Pressure	Positive; approximately +2.5 inH2O
Ambient Temp's	0 °F Min/ 60 °F Dsn/ 100 °F Max

Seismic Design:

Spec. or Standard	ASCE 7 -10
Zone/ Imp. Factor	Zone 2 / 1.25
spare	

Site Design Basis:

Site Elevation	750	ft AMSL	/	229	m AMSL
Stack Design Temp.	90	°F	/	32	°C
FG Discharge Elev., min.	20	ft AG	/	6.1	m AG
Area Classification	base: UNCLASSIFIED				

MAJOR SUBSYSTEMS & ACCESSORIES

Major Services & Subsystems

Process Design	INCLUDED in base pricing
Mechanical Design	INCLUDED in base pricing
Structural Design	INCLUDED in base pricing
Radiant Section	INCLUDED in base pricing
Convection Section	INCLUDED in base pricing
Burner Management	INCLUDED in base pricing
Burner Piping	INCLUDED in base pricing
Forced Draft System	INCLUDED in base pricing

Major Accessories:

Casing/ Tube Seals	8	TubeSox: Radiant & Conv.
Observation Doors	3	3 in Dia. w/ H.T. glass
Observation Doors	None	
Access Doors	1	Std 24" x 24"
Access Doors	None	
Tube Pulling Doors	None	
Pressure Relief Doors	None	
Expansion Joints	None	

Casing Penetrations

Fbox Purge/ Snuff	2	2"NPS 150# RFWN's
CA Temperature	None	
CA Pressure	None	
FG Temperature	3	1.5"NPS 3000# Coupling
FG Pressure	3	1.5"NPS 3000# Coupling
FG Composition	1	1.5"NPS 3000# Coupling
FG Comp. (AE - O2)	2	3"NPS 150# RFWN's
FG Comp. (AE - CO)	1	3"NPS 150# RFWN's
FG Comp. (AE - EPA)	2	4"NPS 150# RFWN's
FG Comp. (AE - CEM)	None	

Pressure Part Penetrations

Coil TSTC's, Radiant	None
Coil TSTC's, Convection	0
Process TI conn's	None
Process PI conn's	None
Velocity Steam conn's	None
S/A Decoking conn's	None
Vent / Drain conn's	None
spare	
spare	
spare	

Dampers:	FD Fan	ref. page 7	Uptake Ducts	quantity =	Stack	quantity =
Function					Note: O2 Control is provided by	
Design					Forced Draft Fan's Inlet Damper	
Materials						
Bearings						
Operator						
Positioner						
Instruments						

Sootblowers:	Qty.	Type	Location	FG T	Material	Steam T & P	O.E.M. / Ref.
Lane 1:	None						
Lane 2 :	None						

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MAJOR SUBSYSTEMS & ACCESSORIES (continued,

								Fin & Rev
Fan Assemblies:		Forced Draft Fan Assembly			Induced Draft Fan Assembly			
FD / ID Fans Design Basis	mass.flow.%	115% of Heater Design Mass Flow						
Quantity of Assemblies	--/%	One (1) Forced Draft Fan Assembly			None Induced Draft Fan Assembly			
Location(s)	---	@ Grade, adjacent to Burner Endwall						
Area Classification	NEC	base: UNCLASSIFIED						
		Heater Design		FD Fan Design or "Test Block"				
Process Design:								
Mass Flow Rate/ % Htr Design	Lb/hr	11,000	100%	12,700	115%			
Volumetric Flow/ % Htr Design	acf3/min	2,500	100%	3,100	124%			
Density, @ Suction & noted T & P	Lb/ft3	0.0744		0.0691				
Design Allowances, Temp./ SP	°F/ %	---	---	40 °F	154%			
Temperature @ Suction, Design	°F	60		100				
Static Pressure @ Suction, Design	inH2O	-0.4		-0.5				
Site Elevation/ Atm. Pressure	ftAMSL/ psia	750	14.33	750	14.33			
Static Pressure Rise (min./ guar.)	inH2O	5.1	t.b.q.	7.6	t.b.q.			
Static Efficiency (min./ guar.)	%	---	t.b.q.	---	t.b.q.			
Fan Speed (allowable/ actual)	RPM	1,780	t.b.q.	1,780	t.b.q.			
Sound Pressure (allowable/ guar.)	dBA	< 85	t.b.q.	< 85	t.b.q.			
Fan Mechanical Design:	fan OEM	t.b.d.						
OEM Reference	---							
OEM Model &/or Type-Size	---							
Arrangement	---	Arrangement 8						
Brake Power (calculated)	HP							
Temperature, Maximum Operating	°F							
Casing Description	---							
Casing Material(s)	---							
Blade Description	---							
Blade & Rotor Assembly Material(s)	---							
Shaft Description	---							
Shaft Seals Description	---							
Bearings Description	---							
Bearing Instrumentation Description	---							
Coupling Description	---							
Silencer Description	---							
External Insulation Provisions	---	None						
External Coatings & Surface Prep.	---	OEM's Std Multiple Coat System on SP-6 Surface						
Purchase Specifications	---							
Fan Control Design:	OEM	t.b.d.						
VFD Description	---							
VFD Rating	---							
Damper Description	---							
Actuator Description	---							
Actuator Operation	---							
External Coatings & Prep.	---	OEM's Std Multiple Coat System on SP-6 Surface						
Motor Design:	mtr OEM	t.b.d.						
OEM Reference	---							
Motor Type / Frame Size	---							
Rated Power w/ SF @ Speed	NEMA							
Local Power	W Hz/ ph							
Rotor Description	---							
Shaft Seals Description	---							
Bearings Description	---							
Insulation Description	---							
spare	---							
External Coatings & Surface Prep.	---	OEM's Std Multiple Coat System on SP-6 Surface						
Purchase Specifications	---							

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MAJOR SUBSYSTEMS & ACCESSORIES (concluded,

Combustion Air PreHeater (CAPH):

Preheater Type: None Specified nor Offered
Location:
OEM; Model & Ref.:
Design Basis Service:

CAPH Process Design:	---	Regen Gas	Combustion Air		
Inlet Temperature / Pressure	°F / psig				
Inlet Temperature / Pressure	°F / inH2O				
Inlet Flow Rate, to CAPH	Lb/ hr				
Outlet Temperature / Pressure	°F / psig				
Outlet Temperature / Pressure	°F / inH2O				
Heat Transfer	MMBTU/ hr				

CAPH Mechanical Design:		
Basis for Tube Thickness	basis	
Design Pressure / Temperature	psig/ °F	/
Corrosion Allowance	in	
Weld Inspection	% of %	
Post Weld Heat Treatment	yes or no	
CAPH Coil Arrangement:	---	
Pipe/Tube Material	ASTM	
Coil NPS & schedule	NPS/ ASME	
Effective Length/ Spacing	ft/ in	/
No. Tubes / Tubes per Row	--- / ---	/

CAPH Extended Surface:		
Fin/Stud Material	---	
Fin/Stud Dimensions	in	
Fin/Stud Density	fpi	
Total Exposed Surface	ft2	

CAPH Manifolds:	---	
Inlet Manifold NPS & sch.	ASTM	
Outlet Manifold NPS & sch	ASTM	
Flange Rating	ASME	
Flange Material	ASTM	

Expansion Provisions:	Qty	Locations	Materials	Dan Movements	Design T & P
Slip Joints	0				
Slip Joints	0				
Fabric Expansion Joints	0		CS & LowTemp Materials	+/- 0.50 Inch	110 F & 8 InH2O
Fabric Expansion Joints	0				

CA Ducting Design:					
Total Refractory Thickness	in	None	Anchor Type	---	None
Hot Face Temperature (design	°F		Anchor Material	---	None
Hot Face Layer	in/ ---	None	Casing	in/ ASTM	0.1875 / A36
Back-Up Layer No.1	in/ ---	None	Internal Coating	ASTM	None

Proposed Ladders & Platforms

Proposal & Design Basis:

1) Construction: 100% Galvanized A36 CS per API Standard 560 / ISO 13705
2) Provisions for External Coating(s) / Painting: None, except as explicitly set forth in THI's proposal
3) Additional L&P's: can be provided per the basis set forth in Sections 8 & 9 of THI's proposal

Component	Qty (--)	Width (ft)	Length (ft)	Arc (°)	O.D. (ft)	Weight (Lbm)	Price (US$)
Radiant Platforms							
Burner Platform	0	3.00	6.00	0	0.00	0	0
Ladder to Grade	0	3.00	6.00			0	0
Stair to Grade	0	3.00	6.00			0	0
Convection Platforms							
Conv. End Platforms	0	4.00	4.53			0	0
Conv. Side Platforms	0	3.00	21.00			0	0
Ladder to Grade	0	3.00	4.00			0	0
EPA Platform	0	3.00		270	9.00	0	0
Ladder to Grade	0	3.00	6.00			0	0
Intermediate Pltfm	0	3.00		90	9.00	0	0
Totals for Proposed Platforms						0	0

H-741 & H-2741

THOMAS RUSSELL CO.

Tulsa, Oklahoma

JOB NO: TRJ-207
CLIENT: Chesapeake Energy
SUBJECT: 120 MMCFD Cryo Plant

DATE: 7/31/2008
BY: AHO

FIRED HEATER

Service:	Regen Gas Heater			Tag No:	H-741
Design Duty, MBTU/Hr	4374			Type:	Helical Coil
No. of Coils per Unit	One	No. Units:	One	Model:	Heatec HCI-4010-40-G

Fluid		Regen Gas Inlet	Regen Gas Outlet	Burners	Gas	Oil
Liquids	Lbs/Hr			LHV (BTU/cf)	905	
Density	Lbs/CuFt			Mol. Wt.	16.2	
Molecular Weight				Gravity		
Specific Heat	BTU/Lb °F			Pressure Avail. (psig)	100	
Thermal Cond.	BTU/Hr-Ft-°F			Pressure Req'd (psig)	10	
Viscosity	cP			Steam for Atomizing		
Vapor	Lbs/Hr	14389	14389	Fuel Gas Req'd (MSCFD)	138.92	N/A
Density	Lbs/CuFt	4.046	1.761	Mfgr:	Eclipse WiNOx	
Molecular Weight		20.16	20.16	Type:	Forced Draft - 20 Hp Blower	
Specific Heat	BTU/Lb °F	0.6512	0.7377	Number Req'd	One	
Thermal Cond.	BTU/HrFt °F	0.02218	0.04329	Pilots Req'd	Yes, electric ignition	
Viscosity	cP	0.01348	0.01947	NOx	40 ppmvd	
Operating Temp.	°F	89	550	**Structural Design**		
Operating Pressure	PSIA	950	940	Wind Load, MPH, (3)		
Velocity	Ft/Sec		20.4 Calc.	Seismic Zone, (3)		
Pressure Drop	PSI	10 Allow.	2 Calc.	Ambient, °F	-20 / 110	
Fouling Resistance	SqFt*F/BTU	0.001		Elevation, Ft	3000	
Design Press. / Temp.		1095 PSIG	650 °F	**Stack Design**		
Min. Design Mtl. Temp.		-20 °F @	1095 PSIG	Self-supporting	Yes	
Corrosion Allowance		0.0625		Minimum Height	8 ft above top of heater	
Insulation Thickness		3-5" high temp ceramic fiber		Minimum Wall Thickness:	0.125	
Efficiency-Based on LHV	(%)	86.0%	(Assume 3% Loss)	Lining Type	No	
Excess Air		15		Lining Thickness:	No	
Firebox Unit Heat Release		32,900	BTU/Hr- Ft^3	Damper:	No	
Number of Passes		One - process , Two fireside				

Coil Design		Radiant	Convection-Bare	Convection-Finned	
Gas Temperature	In/Out	89 / 550			
Number Tubes		One			
Tube O.D.	In	Single Circuit 4"	4" 900# ANSI RTJ Flg	Inlet and Outlet	
Tube Length	Eff. Ft	----			
Bare Surface	Sq Ft	569			
Finned Surface	Sq Ft	N/A			
Avg. Heat Flux	BTU/Hr-Sq Ft	8,084			
Tube Materials		SA-106 Gr.B Sch 80	SA-	SA-	

Convection Fins (inch):	Height:	Thickness:	No. / inch:	Material:	
Overall Dimension:	20' - 4" L x 6' - 0" W x 7' - 0" H (Less Stack)			Dry Weight:	14,600 lbs
Code Requirements:	ASME VIII Div I	Stamp:	Yes	Nat'l Board:	Yes

Notes:

1) Add 30% to duty and add 10% to flow rates for design.
2) See attached Scope of Supply.
3) Wind design per ASCE 7-05, I=1.15, Exposure C. Seismic design per ASCE 7-05, I=1.25, Site D. , S_s=100% , S_1 =40%
4) Electrical power to be 480 v / 3 ph / 60 hz. Control enclosures to be NEMA 4.
5) Add spare ignitor.

REVISION	A	0		
ENGINEER/DATE	AHO | 7/31/08	DDO | 9/3/08	|	|
ISSUED FOR	Check Rate	Purchase		

H-1782 & H-D2782

H-1782 & H-2782

Optimized Process Furnaces, Inc.
Proposal No. 2011-068, Revision 1
01/20/2012

PURCHASER / OWNER: Thomas Russell Co. / MarkWest Ene gy			ITEM NO.:	H-1782		
SERVICE: HMO Heater			LOCATION:	Unknown		
			* NUMBER REQUIRED:	1		REV
1	UNIT		REFERENCE:	2011-068, Revision 1		
2	MANUFACTURER: OPTIMIZED PROCESS FURNACES					
3	TYPE OF HEATER: VERTICAL CYLINDRICAL					
4	* TOTAL HEATER ABSORBED DUTY, MM BTU / HR.	88.6 X 1.10% = 97.5				
5	**PROCESS DESIGN CONDITIONS**					
6	* OPERATING CASE	DESIGN				
7	HEATER SECTION					
8	* SERVICE	HOT OIL				
9	HEAT ABSORPTION, MM BTU / HR.	88.6 X 1.10% = 97.5				
10	* FLUID	THERMINOL 55				
11	* FLOW RATE, LB/HR	1,571,806 X 1.10%				
12	* FLOW RATE, B.P.D.					
13	* PRESSURE DROP, ALLOWABLE (CLEAN / FOULED), PSI.	45				
14	PRESSURE DROP, CALCULATED (CLEAN / FOULED), PSI.	42				
15	* AVG. RAD. SECT. FLUX DENSITY, ALLOW. BTU /HR-FT2.	12000				
16	AVG. RAD. SECT. FLUX DENSITY, CALC., BTU HR-FT2.	12000				
17	MAX. RAD. SECT. FLUX DENSITY, BTU / HR - FT2.	21600				
18	CONV. SECT. FLUX DENSITY, (BARE TUBE), BTU / HR - FT2.					
19	* VELOCITY LIMITATION, FPS.					
20	PROCESS FLUID MASS VELOCITY, LB / SEC - FT2.	599				
21	* MAXIMUM ALLOW. / CALC. INSIDE FILM TEMPERATURE, F.	417				
22	* FOULING FACTOR, HR - FT2 - F / BTU.	0.003				
23	* COKING ALLOWANCE, IN.					
24	**INLET CONDITIONS**					
25	* TEMPERATURE, F.	250				
26	* PRESSURE, (PSIG)	110				
27	* LIQUID FLOW, LB / HR	1,571,806 X 1.10%				
28	* VAPOR FLOW, LB / HR	0				
29	* DENSITY #FT3	58.1				
30	* VAPOR MOLECULAR WEIGHT	0				
31	* VISCOSITY, (LIQUID / VAPOR), CP.	1.8				
32	* SPECIFIC HEAT, (LIQUID / VAPOR), BTU / LB - F.	0.534				
33	* THERMAL CONDUCTIVITY, (LIQUID / VAPOR), BTU / HR - FT F.	0.0858				
34	**OUTLET CONDITIONS**					
35	* TEMPERATURE, F.	365				
36	* PRESSURE, (PSIG)	68				
37	* LIQUID FLOW, LB / HR	1,728,985				
38	* VAPOR FLOW, LB / HR	0				
39	* DENSITY #FT3	52.2				
40	* VAPOR MOLECULAR WEIGHT	0				
41	* VISCOSITY, (LIQUID / VAPOR), CP.	0.738				
42	* SPECIFIC HEAT, (LIQUID / VAPOR), BTU / LB - F.	0.65				
43	* THERMAL CONDUCTIVITY, (LIQUID / VAPOR), BTU / HR - FT F.	0.0625				
44	**REMARKS AND SPECIAL REQUIREMENTS:**					
45	* DISTILLATION DATA OR FEED COMPOSITION:					
46	SHORT TERM OPERATING CONDITIONS					
47						
48	NOTES:					
49						
50						
51						
52						

FIRED HEATER DATA SHEET		PROPOSAL NO.:	2011-068, Revision 1
OPF, Inc.	REV: 1	DATE: 01/20/2012	SHEET 1 OF 6

Optimized Process Furnaces, Inc.
Proposal No. 2011-068, Revision 1
01/20/2012

COMBUSTION DESIGN CONDITIONS

		DESIGN			REV
1	OPERATING CASE				
2	* TYPE OF FUEL	GAS			
3	* EXCESS AIR, PERCENT,	15			
4	CALCULATED HEAT RELEASE (LHV), MM BTU / HR.	113.2			
5	FUEL EFFICIENCY CALCULATED, PERCENT (LHV)	88			
6	FUEL EFFICIENCY GUARANTEED, PERCENT (LHV)	85			
7	RADIATION LOSS, PERCENT OF HEAT RELEASE (LHV)	1.5			
8	FLUE GAS TEMPERATURE LEAVING: RADIANT SECTION, F.	1535			
9	CONVECTION SECTION, F.	860			
10	AIR PREHEATER, F.	-			
11	FLUE GAS QUANTITY, LB / HR	110,220			
12	FLUE GAS MAS VELOCITY THRU CONV. SECTION, LB / SEC-FT2	0.46			
13	DRAFT: AT ARCH, IN-H20	0.1			
14	AT BURNERS, IN-H20	0.63			
15	* AMBIENT AIR TEMPERATURE, EFFICIENCY CALCULATION, F.	80			
16	* AMBIENT AIR TEMPERATURE, STACK DESIGN, F.	80			
17	* ALTITUDE ABOVE SEA LEVEL, FT	1300			
18	VOLUMETRIC HEAT RELEASE (LHV), BTU / HR - FT3	7540			
19	* REQUIRED EMISSIONS: PPMV (@ CORRECTED TO 3% O2)				
20	LB / MMBTU (LHV) (HHV)				

FUEL CHARACTERISTICS:

21	* GAS TYPE		* LIQUID TYPE		* OTHER TYPE		
22	* LHV, BTU / (LB) (SCF)		* LHV, BTU / (LB) (SCF)		* LHV, BTU / (LB) (SCF)		
23	* HHV, BTU / (LB) (SCF)		* HHV, BTU / (LB) (SCF)		* HHV, BTU / (LB) (SCF)		
24	* PRESS. @ BURNER, PSIG		* PRESS. @ BURNER, PSIG		* PRESS. @ BURNER, PSIG		
25	* TEMP. @ BURNER, F		* TEMP. @ BURNER, F		* TEMP. @ BURNER, F		
26	MOLECULAR WEIGHT		* VISCOSITY @ F, SSU				
27			* ATOMIZING STEAM TEMP, F				
28			* PRESSURE, PSIG				
29	COMPOSITION	MOLE %	COMPOSITION	WT%	COMPOSITION	%	
30							
31							
32							
33							
34							
35							
36							
37							

BURNER DATA:

38	MANUFACTURER: CALLIDUS	SIZE / MODEL NO.: CUB-12W		NUMBER:	8
39	TYPE: ULTRA LOW NOX	LOCATION: FLOOR		TURNDOWN RATIO:	3 TO 1
40	HEAT RELEASE PER BURNER, MMBTU / HR:	DESIGN: 14.6		NORMAL:	14.2
41	PRESSURE DROP ACROSS BURNER @ DESIGN HEAT RELEASE, IN H20:	0.63			
42	DISTANCE BURNER CENTER LINE TO TUBE CENTER LINE, HORIZONTAL, IN.:	65	VERTICAL, IN.:	864	
43	DISTANCE BURNER CENTER LINE TO UNSHIELDED REFRACTORY, HORIZ, IN.:		VERTICAL, IN.:	630	
44	* PILOT, TYPE: GAS	CAPACITY, BTU / HR:			
45	* IGNITION METHOD: ELECTRIC			NUMBER:	
46	* FLAME DETECTION, TYPE:				
47	NOTES:				
48					
49					
50					
51					
52					

Optimized Process Furnaces, Inc.
Proposal No. 2011-066, Revision 1
01/20/2012

	MECHANICAL DESIGN CONDITIONS					REV
1	* PLOT LIMITATIONS:		* STACK LIMITATIONS:			
2	* TUBE LIMITATIONS:		* NOISE LIMITATIONS:			
3	* STRUCTURAL DESIGN DATA: WIND VELOCITY:		*WIND OCCURENCE FACTOR:			
4	* SNOW LOAD:		* SEISMIC ZONE:			
5	* MINIMUM / NORMAL / MAXIMUM AMBIENT AIR TEMPERATURE, F:		* RELATIVE HUMIDITY %:			
6	HEATER SECTION:	RADIANT	SHOCK	CONVECTION		
7	SERVICE:					
8	**COIL DESIGN:**					
9	* DESIGN BASIS: TUBE WALL THICKNESS (CODE OR SPECIFICATION):	API RP530				
10	RUPTURE STRENGTH (MINIMUM OR AVERAGE):					
11	* STRESS - TO - RUPTURE BASIS, HR.	100,000				
12	* DESIGN PRESSURE, ELASTIC / RUPTURE, PSIG.	150	150	150		
13	* DESIGN FLUID TEMPERATURE, F.					
14	* TEMPERATURE ALLOWANCE, F.	25 MIN				
15	CORROSION ALLOWANCE, TUBES / FITTINGS, IN.	0.125	0.125	0.125		
16	HYDROSTATIC TEST PRESSURE, PSIG.	230				
17	* POST WELD HEAT TREATMENT, (YES or NO)	NO				
18	* PERCENT OF WELDS FULLY RADIOGRAPHED	10				
19	MAXIMUM (CLEAN) TUBE METAL TEMPERATURE, F.	452				
20	DESIGN TUBE METAL TEMPERATURE, F.	550				
21	INSIDE FILM COEFFICIENT, BTU / HR FT2 - F.	249				
22	**COIL ARRANGEMENT:**					
23	TUBE ORIENTATION: VERTICAL or HORIZONTAL	VERTICAL	HORIZONTAL	HORIZONTAL		
24	* TUBE MATERIAL (ASTM SPECIFICATION OR GRADE)	A106 GRB	A106 GRB	A106 GRB		
25	TUBE OUTSIDE DIAMETER, IN.	6.625	6.625	6.625		
26	TUBE WALL THICKNESS, (MINIMUM) (AVERAGE), IN.	0.28	0.28	0.28		
27	NUMBER OF FLOW PASSES	4	4	4		
28	NUMBER OF TUBES	80	16	40		
29	NUMBER OF TUBES PER ROW (CONVECTION SECTION)		8	8		
30	OVERALL TUBE LENGTH, FT.	60.00	20.00	20.00		
31	EFFECTIVE TUBE LENGTH, FT.	51.50	18.00	18.00		
32	BARE TUBES: NUMBER	80	16	-		1652
33	TOTAL EXPOSED SURFACE, FT2.	5804	284	(1) -		
34	EXTENDED SURFACE TUBES: NUMBER	-	-	40		
35	TOTAL EXPOSED SURFACE, FT2.	-	-	18,960		
36	TUBE LAYOUT (IN-LINE or STAGGERED)	IN-LINE	STAGGERED	STAGGERED		
37	TUBE SPACING, CENT. TO CENT.: HORIZ x DIAG. (OR VERT.)	12	12	12		
38	SPACING TUBE CENT. TO FURNACE WALL, (MIN.), IN.	9	6	6		
39	CORBELS (YES or NO)			YES		
40	CORBEL WIDTH, IN.					
41	**DESCRIPTION OF EXTENDED SURFACE:**					
42	TYPE: (STUDS) (SERRATED FINS) (SOLID FINS)			SOLID FIN		
43	MATERIAL			CS		
44	DIMENSIONS (HEIGHT x DIAMETER / THICKNESS), IN.			1 X .060		
45	SPACING (FINS / IN) (STUDS / PLANE)			6		
46	MAXIMUM TIP TEMPERATURE, (CALCULATED), F.			<650 F		
47	EXTENSION RATIO (TOTAL AREA / BARE AREA)			-1		
48	**PLUG TYPE HEADERS:**					
49	* TYPE					
50	MATERIAL (ASTM SPECIFICATION AND GRADE)					
51	NOMINAL RATING					
52	* LOCATION (ONE OR BOTH ENDS)					
53	WELDED OR ROLLED JOINTS					
54	NOTES: (1) BOTTOM BARE ROW INCLUDED IN RADIANT SECTION SURFACE					
55						
56						
57						
58						

MECHANICAL DESIGN CONDITIONS (Continued)

							REV
1	HEATER SECTION	RADIANT	SHOCK	CONVECTION			
2	SERVICE						
3	**RETURN BENDS:**						
4	TYPE	U-BEND	U-BEND	U-BEND			
5	MATERIAL (ASTM SPECIFICATION AND GRADE)	A234 WPB	A234 WPB	A234 WPB			
6	NOMINAL RATING OR SCHEDULE	40	40	40			
7	* LOCATION (FB=FIREBOX, HB=HEADERBOX)	FIREBOX	HEADER BOX	HEADER BOX			
8	**TERMINALS AND / OR MANIFOLDS:**						
9	* TYPE (BEV=BEVELED, MANF=MANIFOLD, FLG=FLANGED	FLANGED		FLANGED			
10	INLET: MATERIAL (ASTM SPECIFICATION AND GRADE)			A105 GRB			
11	SIZE / SCHEDULE OR THICKNESS						
12	NUMBER OF TERMINALS			4			
13	FLANGE MATERIAL (ASTM SPECIFICATION AND GRADE)			A105			
14	FLANGE SIZE AND RATING			300#			
15	OUTLET: MATERIAL (ASTM SPECIFICATION AND GRADE)	A106 GRB					
16	SIZE / SCHEDULE OR THICKNESS						
17	NUMBER OF TERMINALS	4					
18	FLANGE MATERIAL (ASTM SPECIFICATION AND GRADE)	A105					
19	FLANGE SIZE AND RATING	300#					
20	* MANIFOLD TO TUBE CONNECTION (WELDED, EXTRUDED, ETC.)						
21	MANIFOLD LOCATION (INSIDE OR OUTSIDE HEADER BOX)	BY OTHERS		BY OTHERS			
22	**CROSSOVERS:**						
23	* WELDED OR FLANGED		WELDED				
24	* PIPE MATERIAL (ASTM SPECIFICATION AND GRADE)		A106 GRB				
25	PIPE SIZE / SCHEDULE OR THICKNESS		40				
26	* FLANGE MATERIAL		NONE				
27	FLANGE SIZE AND RATING		NONE				
28	* LOCATION (INTERNAL / EXTERNAL)		EXTERNAL				
29	FLUID TEMPERATURE, F.						
30	**TUBE SUPPORTS:**						
31	LOCATION (ENDS, TOP, BOTTOM)	TOP	ENDS	ENDS			
32	MATERIAL (ASTM SPECIFICATION AND GRADE)	25%CR 20%NI	A36	A36			
33	DESIGN METAL TEMPERATURE, F.						
34	THICKNESS, IN. (MIN.)		1/2	1/2			
35	TYPE AND THICKNESS OF INSULATION, IN.		4" LHV	4" LHV			
36	ANCHOR (MATERIAL AND TYPE)						
37	**INTERMEDIATE TUBE SUPPORTS:**	ONE					
38	MATERIAL (ASTM SPECIFICATION AND GRADE)	25%CR 20%NI					
39	DESIGN METAL TEMPERATURE, F.						
40	THICKNESS, IN. (MIN.)						
41	SPACING, FT.						
42	**TUBE GUIDES:**						
43	LOCATION	BOTTOM					
44	MATERIAL (ASTM SPECIFICATION AND GRADE)	25%CR 20%NI					
45	TYPE / SPACING, FT.						
46	**HEADER BOXES:**						
47	LOCATION: CONVECTION ENDS	HINGED DOOR / BOLTED PANEL; BOLTED PANEL					
48	CASING MATERIAL: A36	THICKNESS, IN. 3/16					
49	LINING MATERIAL: 1" -8# CERAMIC FIBER	THICKNESS, IN. 1					
50	ANCHOR (MATERIAL AND TYPE) 304 SS						
51	NOTES:						
52							
53							
54							

MECHANICAL DESIGN CONDITIONS (Continued)

							REV
1	**REFRACTORY DESIGN BASIS:**						
2	AMBIENT, F:80	WIND VELOCITY, MPH / FPS		CASING TEMP., F.			
3	**EXPOSED VERTICAL WALLS: (NONE)**						
4	LINING THICKNESS, IN.:	HOT FACE TEMPERATURE, DESIGN / CALCULATED, F:					
5	WALL CONSTRUCTION:						
6							
7	ANCHOR (MATERIAL & TYPE):						
8	CASING MATERIAL:	THICKNESS, IN.:		TEMPERATURE, F.			
9	**SHIELDED VERTICAL WALLS:**						
10	LINING THICKNESS, IN.: 3"	HOT FACE TEMPERATURE, DESIGN / CALCULATED, F: 2300F/ 840					
11	WALL CONSTRUCTION: 1" -8# CERAMIC FIBER + 2" - 6# CERAMIC FIBER						
12							
13	ANCHOR (MATERIAL & TYPE): 304 SS						
14	CASING MATERIAL: A36	THICKNESS, IN.: 1/4"		TEMPERATURE, F.		180 F	
15	**ARCH:**						
16	LINING THICKNESS, IN.: 4	HOT FACE TEMPERATURE, DESIGN / CALCULATED, F: 2300/ 1530					
17	WALL CONSTRUCTION: 2" - 8# CERAMIC FIBER + 2" - 8# CERAMIC FIBER						
18							
19	ANCHOR (MATERIAL & TYPE): 310 SS						
20	CASING MATERIAL: A36	THICKNESS, IN.: 1/4"		TEMPERATURE, F.		180 F	
21	**FLOOR:**						
22	LINING THICKNESS, IN.: 6	HOT FACE TEMPERATURE, DESIGN / CALCULATED, F: 2000 / 1830					
23	FLOOR CONSTRUCTION: 6" 1:2:4 L.H.V. CASTABLE						
24							
25	CASING MATERIAL: A36						
26	MIN. FLOOR ELEVATION, FT.	FREE SPACE BELOW PLENUM, FT:					
27	**CONVECTION SECTION:**						
28	LINING THICKNESS, IN.: 3	HOT FACE TEMPERATURE, DESIGN / CALCULATED, F: 2300 / 970					
29	WALL CONSTRUCTION: 1" -8# CERAMIC FIBER + 2" - 6# CERAMIC FIBER						
30							
31	ANCHOR (MATERIAL & TYPE): 304 SS						
32	CASING MATERIAL: A36	THICKNESS, IN.: 3/16		TEMPERATURE, F.		180 F	
33	**INTERNAL WALL:**						
34	TYPE:	MATERIAL:					
35	DIMENSION, HEIGHT / WIDTH:						

	DUCTS:	**FLUE GAS**			**COMBUSTION AIR**		
37	LOCATION	BREECHING					
38	SIZE, FT. OR NET FREE AREA, FT2						
39	CASING MATERIAL						
40	CASING THICKNESS, IN.						
41	LINING: INTERNAL / EXTERNAL						
42	THICKNESS, IN.						
43	MATERIAL						
44	ANCHOR (MATERIAL & TYPE)						
45	CASING TEMPERATURE, F.						

46	**PLENUM CHAMBER (AIR)**			
47	CASTING MATERIAL:	THICKNESS, IN.:	SIZE, FT:	
48	LINING MATERIAL:		THICKNESS, IN.:	
49	ANCHOR (MATERIAL & TYPE)			
50	NOTES:			
51				
52				
53				

MECHANICAL DESIGN CONDITIONS (Continued)

REV

STACK OR STACK STUB:

NUMBER:	1	SELF-SUPPORTED OR GUYED:	SELF SUPPORTED	LOCATION: TOP OF CONVECTION	
CASING MATERIAL:	A36	* CORROSION ALLOWANCE, IN.:		THICK., IN. (MIN):	1/4"
OUTSIDE METAL DIA., FT.:	7' - 6"	HEIGHT ABOVE GRADE, FT.:		LENGTH, FT.:	80' - 0"
LINING MATERIAL:	NONE			THICKNESS, IN.:	NONE
ANCHOR (MAT'L AND TYPE):		NONE			
DESIGN FLUE GAS VEL., FT/S:		FLUE GAS TEMPERATURE, F.:	650		
EXTENT OF LINING:	NONE	INTERNAL OR EXTERNAL:	NONE		

DAMPERS:

LOCATION:	STACK			
TYPE (CONTROL, TIGHT SHUT-OFF, ETC.)	CONTROL			
MATERIAL: BLADE	CS			
SHAFT	CS			
MULTIPLE / SINGLE LEAF	MULTIPLE			
PROVISION FOR OPERATION (MANUAL OR AUTOMATIC)	WINCH			
TYPE OF OPERATOR (CABLE OR PNEUMATIC)	CABLE			

MISCELLANEOUS:

PLATFORMS: LOCATION	NUMBER	WIDTH	LENGTH	STAIRS / LADDER	ACCESS FROM

TYPE OF FLOORING:

	NUMBER	LOCATION	SIZE	BOLTED/HINGED
DOORS:				
ACCESS				
OBSERVATION				
TUBE REMOVAL				

INSTRUMENT CONNECTIONS:	NUMBER	SIZE	TYPE
FLUE GAS / COMBUSTION AIR TEMPERATURE			
FLUE GAS / COMBUSTION AIR PRESSURE			
FLUE GAS SAMPLE			
SNUFFING STEAM / PURGE			
O2 ANALYZER			
CO OR NOX ANALYZER			
VENTS / DRAINS			
PROCESS FLUID TEMPERATURE			
TUBESKIN THERMOCOUPLES			

PAINTING REQUIREMENTS:

INTERNAL COATING:

GALVANIZING REQUIREMENTS:

ARE PAINTERS TROLLEY AND RAIL INCLUDED:

SPECIAL EQUIPMENT: SOOTBLOWERS:

ANCHOR (MATERIAL & TYPE): AIR PREHEATER:

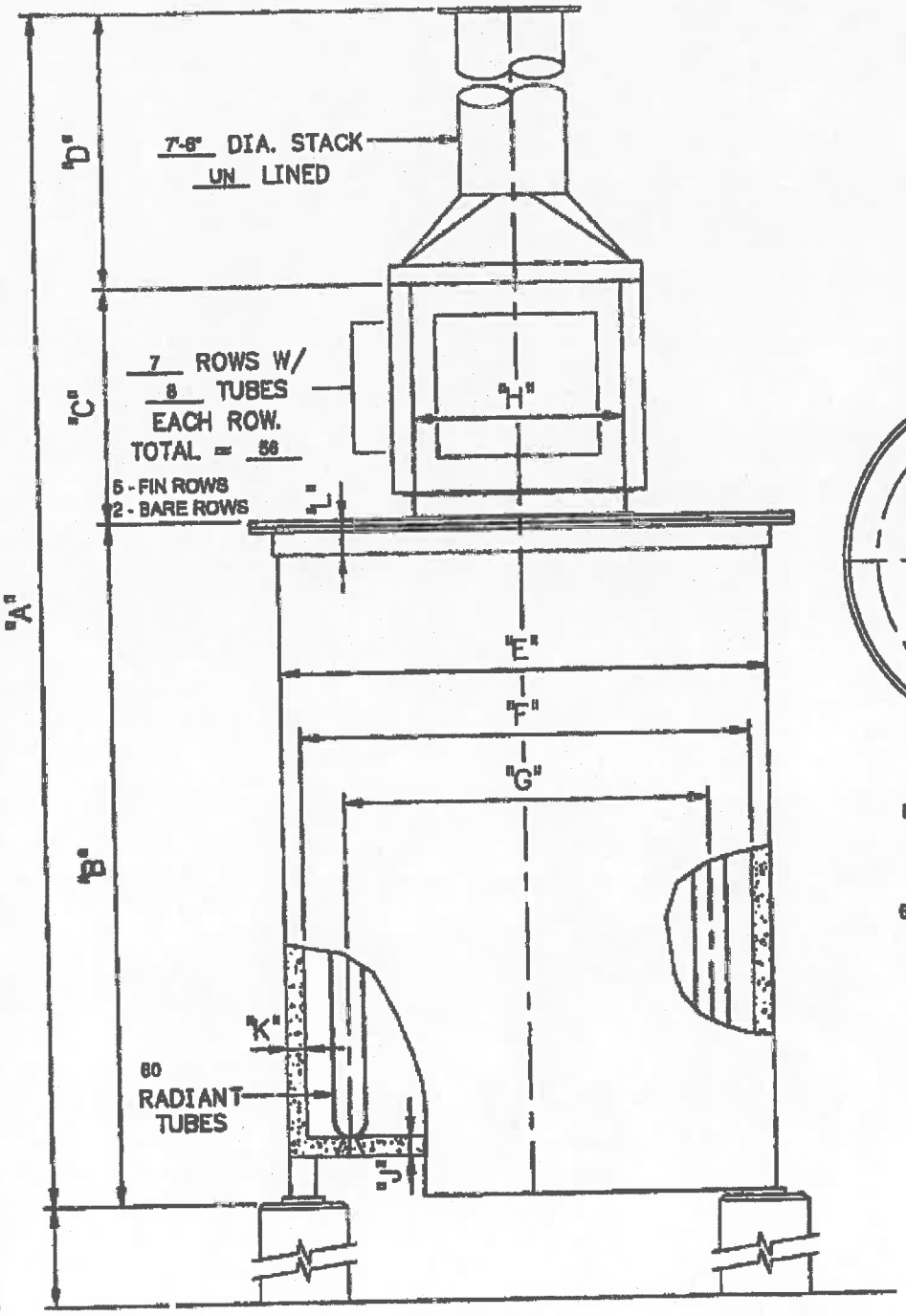
FANS:

OTHER:

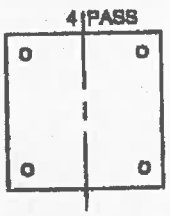
NOTES:

H-1782 & H-D2782

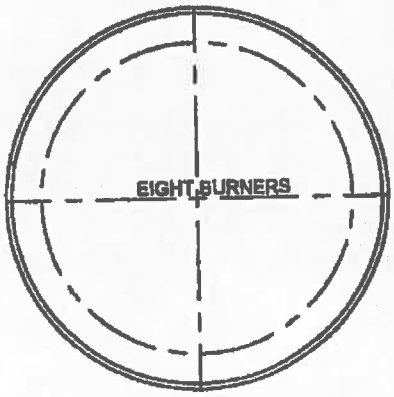
PROPOSAL NO. 2011-066, REVISION 1
01/23/2012



SCHEMATIC FLOW



CONVECTION



RADIANT
INLETS AND OUTLETS BOTTOM

60 - S.R.R.B.

DIMENSION SCHEDULE

"A"	"B"	"C"	"D"	"E"	"F"	"G"	"H"	"J"	"K"	"L"			
144'-3"	54'-6"	9'-6"	80'-0"	21'-1"	20'-7"	19'-1"	9'-0"	6"	3"				

OPTIMIZED PROCESS FURNACES, INC.
P.O. BOX 706
CHANUTE, KANSAS 66720

TITLE: HMO HEATER
ITEM NO. H-1782

PROPOSAL NO. 2011-066, REVISION 1 | REV. 1

BURNER PERFORMANCE DATA

Operating Conditions

The burners for this project are designed for the following conditions:

End User: Unknown
Job Site: Unknown
Heater: 2011-066

Burner Model	CUBL-12W
Number of Burners	8
Maximum Heat Release (MMBtu/hr)	14.90
Normal Heat Release (MMBtu/hr)	14.20
Minimum Heat Release (MMBtu/hr)	2.98
Excess Air (%)	15
Available Draft (" W.C.)	0.630
Air Temperature (°F)	Ambient
Bridgewall Temperature (°F)	1,535
Gas Pressure (psig)	25
Estimated Visual Flame Length (Ft.)	25
Estimated Visual Flame Diameter (Ft.)	3.4
Elevation (Ft. ASL)	1,300
Tube Circle Diameter (Ft.)	19.08
Burner Circle Diameter (Ft.)	8.5
Meets API Recommended Clearance?	Yes

Description of CUBL Burner Technology

The Callidus Ultra Blue Burners are the latest technological improvement in NO_x reduction. This advancement has been achieved through the use of special techniques to lower the burner's peak flame temperature. The Ultra Blue "CUBL" burner provides NO_x emissions that are 40-50% lower than the current Ultra Low NO_x burner technologies.

The Callidus Ultra Blue Burner technology combines staged fuel and flue gas recirculation technologies to produce the next generation in NO_x reduction technology. We utilize the pressure "energy" of the primary fuel gas to pull inert flue gases into the combustion zone. This cools the oxidative reaction and produces very low NO_x emissions. Burner mixing is optimized because fuel gas (mixed with inert flue gas) enters the burner throat perpendicular to the incoming combustion air stream. All of these advantageous NO_x reduction features are without the need for expensive post-combustion emission or fuel altering equipment. CO is virtually eliminated, and flame envelope is minimized.

Equipment Description

The proposed burners will be manufactured complete with the following:

Burner Plenum	Common or Integral	Integral
	Material	Carbon Steel
	Plate Thickness	10 Gage
Inlet Air Control	Damper or Register	Opposed Blade Damper
	Mode of Operation	Manual
Burner Tile	Composition	60% Al_2O_3
	Max. Service Temperature	3000°F
Insulation	Type	Mineral Wool
	Thickness	1"
Noise Muffler	Yes/No	Yes
Pilot	Ignition Method	Fixed Ignition Rod
	Flame Detection	No
	Connection	½" FNPT
	Fuel	Natural Gas
	Fuel Pressure (psig)	7-10
	Capacity (MMBtu/hr)	0.10
Ignition Port	Size/Quantity	2"/1
Sight Port	Size/Quantity	2"/1
Scanner Connection	Size/Type	1" Swivel
	Quantity	1
Gas Manifold	Material	CS
	Connection	2" MNPT
Gas Tips/Risers	Tip Material	CK-20
	Riser Material	304SS
	Connection To Manifold	3000# SW Unions
Waste Gas Manifold	Material	304SS
	Connection	½" MNPT
	Tip Material	CK-20
Surface Requirements	Preparation	SSPC-SP-2
	Primer	1 Coat Blue Oxide

Guaranteed Emission Values

The burner's expected NO_x emissions, based on each fuel's lower heating value, are as follows:

Expected #/MMBtu NO_x	Guaranteed #/MMBtu NO_x
0.026	0.030 (Note #1)

Carbon Monoxide (CO) ..... 0.~~0000~~ ,04 lb/MMBtu
(Basis: 1500°F min. Radiant Fire Box Temperature, 2% to 4% volume (dry) Oxygen in Combustion Products, Reported as Methane, HHV.)

Note #1: NO_x guarantee does not include the case when Waste Gas is run.

Guaranteed Noise Level

At 3 feet from burner ..... 85 dB(A)

H-3741 & H-4741

SYSTEM PARAMETERS

The recommendations in this proposal are based on the following parameters:	
Heater location	Unknown
Plant elevation	Maximum 2,000 ft
Heater location	Outdoor
Heat load (normal)	5,794,562 Btu/hr x 1.3
Heater burner input (normal)	7,689,564 Btu/hr
Flow rate	20,840 Lbs/Hr x 1.10
Heater pressure loss (normal)	5 P.S.I.D.
Average heat flux (normal)	7,820 Btu/hr/ft²
Combustion loading (normal)	26,038 Btu/hr/cu. ft
Electrical	480/3/60
Controls	NEMA 4
Primary fuel Standard Natural Gas only	Fuel gas
Gas pressure required	10 PSIG
Insurance requirements	IRI
ASME Code	650 °F. @ 1095 PSIG
Heater turndown	3:1
Heat Medium	Regeneration Gas
Supply temperature	550°F
Return temperature	135°F
Expected NOx	40 ppm

EQUIPMENT RECOMMENDATIONS:

HEATER PACKAGE:

In the majority of all process heaters, 70% or more of all heat transferred occurs in the radiant section of a heater. Proper design of this section is the single most important factor to consider when selecting a heater. For your application we recommend one (1) Horizontal Helical Coil Heater, Model HCI-5010-40-G designed for an output of 5,794,562 x 1.3 Btu's/hr. The heater will raise the regeneration gas temperature from 135°F to 550°F at a flow rate of 20,840#/hr ± 1.10 while the heat transfer coil pressure drop is is 5.0 PSI. The average radiant flux rate for the helical coil heater is much lower than that observed in serpentine coil or three pass design heaters. The result will be significant increase in heater life. This model heater is a helical coil, two pass design utilizing a radiant and convection section for heat transfer. The heater is designed, manufactured, wired, and tested at our facility in Chattanooga, Tennessee USA. It is completely packaged and will include:

- **High media velocity Single Circuit 4" SA106 Gr. B seamless, Schedule 80 helical coil with an ASME section VIII stamp for 1095 PSIG @ 650 °F with a CA = .0625" with 4" 900 # RTJ flanges on inlet and outlet.**
- **Coil is hydrostatically tested per ASME code and will receive National Board for pressure vessels registration**
- **3/8" thick A36 carbon steel shell & end covers**
- **The end covers, which are bolted to the heater to allow easy coil removal, should the heater ever need to be repaired. Covers are equipped with lifting eyes for servicing.**
- **3-5" thick high temperature ceramic fiber blanket insulation with seams overlapped on interior of heater shell and end covers to provide an average skin temperature of 140-160 °F with an ambient temperature of 70 °F and 5 MPH wind.**
- **Rear cover contains a 18" bolted manway in rear cover for access to heater internals and blast gate type peep sight allows one to inspect flame conditions and assure there is no flame impingement.**
- **Inert gas smothering connection in front cover (Gas and controls by others).**
- **Structural steel skid with fabricated saddles and 4 skid lifting lugs welded to A36 channels to form a complete skid mounted frame.**
- **304 stainless steel coil supports located in the convection zone where they remain cooler**
- **Stack rain cap and bird screen**

(Spreader bars, by customer, need to be used for positioning unit at the installation site).

Burner:

An Eclipse WiNOx forced draft burner is provided for natural gas only combustion for maximum 2,000 ft elevation. Burner, fuel train(s) and controls are completely packaged and tested to arrive at customer's site requiring no additional assembly. The pilot will be natural gas with the standard ignition procedures. Estimated emissions (Corrected to 3% O2) are as follows:

NOx - 40 PPMVD
CO – 50 PPMVD

Burner includes:

- Direct spark ignited natural gas pilot (Interrupted type)
- UV Flame detection scanner for proving main and pilot flames
- Ignition transformer
- Nameplate on burner stating the burner rated maximum input (HHV)
- A 20 hp Combustion air blower with TEFC motor for 480V/3PH/60HZ
- Combustion air duct with damper and modulation motor containing low / high fire proof switches
- Locally mounted low combustion air pressure switch

Pilot Gas Fuel Train

Pilot gas train supplied to NEMA 4 requirements. Fuel train will consist of all NPT connections and typical NFPA requirements. The fuel train includes:

- Pressure regulator
- Safety shutdown valve
- Solenoid vent valve
- Manual ball valve (UL listed)
- Pressure gauge with isolation valve
- Pilot gas train will be painted yellow

Main Gas Fuel Train

Main gas train supplied to NEMA 4 requirements. Fuel train will consist of NPT connections and typical NFPA requirements. . The fuel train includes:

- Pressure regulator
- Dual automatic safety shutdown valves with a proof of closure switches
- Solenoid vent valve
- Locally mounted high and low pressure switches
- Two (2) manual ball valves (UL listed)
- Butterfly valve
- Fuel modulation valve
- Sampling ports
- Pressure gauge with isolation valve
- Strainer
- Drip leg
- Pressure relief valve
- Main gas train will be painted yellow

Electrical Controls Enclosure:

Control Panel

A NEMA 4X 316 SS (UL Listed) enclosure, wired to meet NEMA 4 and NEC requirements, is mounted on the front face of the heater frame. The enclosure utilizes digital controllers, touch safe design, solid state components and is wired to meet NEC requirements. It is designed, manufactured and tested at our facility. The enclosure design separates low and high voltages to eliminate electromotive force interference and includes the following.

- Honeywell burner management system (U.L. listed as a burner management system as required by NFPA)
- Fireye E-300 First Out Annunciator
- Control relays
- Numbered terminal strips with enclosed wiring raceways
- Yokogawa series temperature controller (indicating)
- Yokogawa series high media temperature limit switch (indicating) with manual reset
- Yokogawa series high stack temperature limit switch (indicating) with manual reset
- Indicating lights for: power on, ignition, main fuel, pump on, blower on, burner on and alarm silenced
- Switches for: burner off/on, alarm silence, low fire hold.
- Flame safety reset button
- Manual emergency trip switch
- Alarm horn, to indicate flame failure (mounted adjacent to panel)

Locally mounted instruments included are:

- Low or no flow media (Regen Gas) Contacts and devices by customer for shutdown of heater.
- Inlet & Outlet pressure gauge with shut off cock
- Inlet & Outlet thermometer with thermowell and equal length stem
- Duplex process thermocouple
- Stack thermocouple
- Pressure relief valve connection on the outlet of heater process piping (1" NPT) (Valve by customer)
- Graphite paste will be used on all threaded process connections

NOTE: NO ANALYZERS OR FLOW METERS/RECORDERS OF ANY KIND OFFERED IN THIS PROPOSAL.

Electrical Test:

An electrical continuity test is performed on every heater. The burner firing is simulated prior to shipment.

Stack:

The flanged stack will bolt on to the flue gas outlet of the heater.

Stack will extend a minimum of 8 feet above top of heater. The stack with bird screen, rain cap and flanged bottom connection will ship loose with the heater. Field reattachment is required by customer.

Note: **Platform and ladders not included nor required.**

Approximate Physical Data (Horizontal Helical Coil Heater Only):

25.5' L. x 7.2'W x 7.9'H (Less Stack)	
Dry 15,800 Lbs.	

Painting:

All external metal surfaces will be white metal sandblasted per SSPC-SP10.
After sandblasting a primer coat of 2 to 3 mil thick will be applied followed by one topcoat.
On all fabricated metal surfaces above 450°F, a top coat of High Heat Paint, 1 ½ to 2 mil thick will be applied.
All purchased accessory items will remain as coated by the original manufacturers.

Shipping:

The major components of shipment are as follows:

A) Heater shell assembly
B) Stack assembly
C) (1) Lot of bolts, nuts and gasket materials

INVESTMENT:

ITEM DESCRIPTION	PRICE
HCI 5010-40-G Heater, Burner, Burner Management, Controls & Stack	

***These prices are valid for 90 days.**

Taxes:

All taxes which Heatec may be required to pay to any government (foreign, federal, state or municipal) upon sale or transportation of the equipment involved will require reimbursement.

Special Note:

Because of increased enforcement of a Tennessee State Law, Heatec must add Tennessee State Sales Tax to the purchase price of equipment if the transfer of ownership occurs in the State of Tennessee. Transfer of ownership, by definition, occurs when a Freight Company hired by the Customer or Customer owned transport(s) pickup the equipment. Please make special note that Tennessee State Tax is 6% of the purchase price, plus $36.00 and this amount will be added when ownership transfer in the State of Tennessee is applicable. To eliminate this additional cost, Heatec will arrange shipping, using Customer guidance if requested. Actual freight costs will or can be prepaid and invoiced to the Customer.

Terms of payment:

Purchaser shall pay the purchase price in progress payments as follows:
30% at thirty (30) days ARO, after receipt of order. This corresponds to the typical issue of approval drawings (if applicable).*
40% at sixty (60) days ARO after receipt of order. This corresponds to the typical completion of the coil or purchase of major components.*
Balance on shipment.
All invoices due on receipt.
*Receipt of these progress payments is required before the equipment will be released for shipment.

H-3781, H-4781 &
H-7781 H-781 HMO Heater for Cryo H-3781
- Maj III & II will have one heater between them

FIRED THERMAL FLUID HEATER SYSTEM PARAMETERS:

The recommendations in this proposal are based on the following parameters:

Heater capacity Normal (Duty):	**11,214,317 X 1.10 Btu/hr**
Thermal fluid circulation rate:	**246,604 lbs/hr**
Fluid temperature (Heater outlet):	**330 °F**
Fluid temperature (Heater inlet):	**245 °F**
Plant location:	Unknown
Plant elevation:	2000 fasl Maximum
Heater location:	Outdoor
Burner turndown:	10:1
Burner input required (HHV):	**14,606,841 Btu/hr X 1.10**
Stack temperature: Normal	596 °F
Heater orientation:	Horizontal
Heater efficiency:	**85% (LHV)**
Fuel:	Gas
Electrical:	**440 V / 3 PH / 60 Hz**
Controls:	**NEMA 4**
Pump head design:	150 ft
Insurance / code requirements:	NFPA 8501 / FM / ASME
Thermal fluid:	**Therminol 62**
Heater volume:	816 Gallons
Design of heater coil and expansion tank:	400 °F @ 150 PSIG w/ CA = .0626"

EQUIPMENT RECOMMENDATIONS:

Heater:

The heater will be a model HCI-10010-40(D)-G two pass design for a duty of **11,214,317 Btu's/hr X** 1.10 to meet your process design conditions. The heater will include:

- Single circuit 6" SA106 Gr. B seamless, 40 helical coil
- ASME section VIII stamp for 150 PSIG @ 400 °F with a CA = .0625"
- 6" - 300 # RFWN coil flanges on inlet and outlet.
- Coil hydrostatically tested per the ASME code
- National Board for pressure vessels registration
- A36 Carbon steel shell
- 3 - 5" thick high temperature ceramic fiber blanket insulation on heater shell and covers to provide an average skin temperature of 140-160 °F with an ambient temperature of 70 °F and 5 MPH wind.
- Rear cover peep sight
- Structural steel skid mounting
- 4 skid lifting lugs, 2 on top and 2 near the bottom of the heater shell
- Shell and structural steel will receive surface preparation to SSPC-SP10 and a surface coat of primer and one top coat.
- Stack, 8 ft. above top of heater

Burner

A forced draft Eclipse Ratiomatic burner is provided for natural gas combustion. The burner will be the modulation type for a 10:1 turndown. The pilot will be natural gas with the standard ignition procedures. Burner will require natural gas to the inlet of the fuel train. Estimated emissions: (Corrected to 3% O2) are as follows:

NOx - <75 PPMVD
CO – <100 PPMVD

Burner includes:

- Direct spark ignited natural gas pilot (Interruptible type)
- UV Flame detection scanner
- Ignition transformer
- Nameplate on burner stating the burner rated maximum input (HHV)

Combustion Air Train:

- Combustion air blower with 40 HP (TEFC) motor for 440V/60HZ/3PH
- Combustion air damper with pneumatic modulation motor with low and high fire proof switches
- Locally mounted low combustion air pressure switch

Pilot Gas Fuel Train:

Pilot gas train supplied to typical NFPA 8501 / FM requirements and will meet NEMA 4 requirements and will consist of carbon steel (SA-106B) connections. The fuel train includes:

- Pressure regulator
- An automatic safety shutdown valve with proof of closure switches
- Solenoid vent valve
- Manual ball valve (UL listed)
- Pressure gauge with isolation valve
- Pilot gas train will be painted yellow

Main Gas Fuel Train:

Main Fuel train supplied to typical NFPA 8501 / FM requirements. Fuel train controls will meet NEMA 4 requirements and will consist of carbon steel (SA-106B) connections. The fuel train includes:

- Pressure regulator
- Two (2) automatic safety shutdown valves with proof of closure switches
- Solenoid vent valve
- Locally mounted high and low pressure switches
- Two (2) manual ball valves (UL listed)
- Strainer
- Butterfly valve
- Fuel modulation valve
- Sampling ports
- Pressure gauge with isolation valve
- Main fuel train will be painted yellow and will be placed along side of the heater support

Electrical Controls:

A NEMA 4X (UL Listed) 316 Stainless Steel Enclosure, wired to meet NEMA 4 and NEC requirements, is mounted on the heater frame and includes the following:

- Panel door disconnect switch with external operating handle.
- **Fireye E-110 burner management system with E-300 first out annunciator**
- Step-down transformer for 120 volt control circuitry.
- Control relays.
- Numbered terminal strips with enclosed wiring raceways.
- Yokogawa series temperature controller.
- Yokogawa series high fluid temperature limit.
- Yokogawa series high stack temperature limit.
- All controllers will be housed in a NEMA 4 window kit.
- Indicating lights for: power on, ignition, main fuel, pump on, blower on, burner on and alarm silenced.
- Switches for: burner off/on, heater off/on, alarm silence, low fire hold.
- Flame safety reset button.
- Alarm horn, to indicate flame failure (mounted adjacent to panel).
- Full set of dry contacts for all alarms for customer use.

Locally mounted instruments included are:

- **Low differential / high pressure switch for low flow shutdown**
- **Inlet pressure gauge with shut off cock.**
- **Outlet pressure gauge with shut off cock**
- **Inlet thermometer with thermowell**
- **Outlet thermometer with thermowell**
- **Stack thermocouple.**
- **Pressure relief valves on the outlet of heater process piping (3/4" x 1" NPT)**

Note: Relief valves must be piped to safe location.

CIRCULATION SYSTEM:

The pre-piped circulating pumps/motors, expansion tank and piping to be mounted on the heater skid and includes:

- **Two (2) Dean 4 X 6 X 8-1/2 -centrifugal pumps *with Tandem Seals Plan 21 with convection air cooled primary seal and Plan 52 secondary seal. Seal Pot shall and have LSH, LG, PI Orifice union on vent and drain valve. Convection air cooler by others.* (300 # RFWN flanged inlet and outlet) with base, coupling, seals and coupling guard. Pump and motor sized based on 150 ft hd.**
- **Pump will include:**
- **40 HP TEFC, 3600 RPM Motor**
- **Suction gate isolation valve**
- **Butt weld suction strainer with drain valve**
- **Butt weld suction stainless steel expansion bellows (Double braided)**
- **Suction vacuum/pressure gauge with isolation valve**
- **Discharge gate isolation valve**
- **Butt weld discharge stainless steel expansion bellows (Double braided)**
- **Discharge pressure gauge with isolation valve**

The electrical enclosure will contain:

- **Pump #1/#2 off/on switch on heater panel face**
- **Motor starters mounted in heater electrical panel**

Note: The pumps/motors will need to be laser aligned in the hot and cold modes. Alignment by others.

EXPANSION TANK:

The expansion tank will be for mounting on top of the pump skid or on top and rear of heater shell. Tank sized based on a total system fill of 2,970 gal. Including the heater and will include the following:

- **Horizontal configuration**
- **1000 Gallon capacity**
- **Saddles for mounting on top rear of heater shell.**
- **ASME VIII stamp for 150 PSIG @ 400 °F w/ CA = .0625"**
- **2:1 Elliptical Heads**
- **RFSO expansion connection with 300 # RFWN isolation gate valve**
- **RFSO vent / fill connection with blind flange and ¾" gate valve**
- **¾" NPT relief valve connection with ASME Section VIII relief valve**
- **$^1/_2$" NPT blanket connection**
- **Reflex level gauge**
- **Low level switch**
- **Gas blanket system (gas supply from customer) to consist of:**
  - **Manual gate valve**

- **Regulator**
- **Relief valve to maintain a 30 - 40 PSIG blanket on the system**
- **Pressure gauge**

8' STACK:

The stack will include the following:

- **Two (2) sampling connections**
- **Rain Cap**
- **After surface preparation to SSPC-SP6 and a coat of high temperature paint**

The stack will extend 8' above the top of the heater.

STANDARD PAINTING:

All external metal surfaces will be commercially sandblasted per SSPC-SP6.
On all fabricated metal surfaces below 450°F, one primer coat followed by a top coat of gray enamel paint, 2 to 3 mil thick will be applied.
On all fabricated metal surfaces above 450°F, a top coat of High Heat paint, 1 ½ to 2 mil thick will be applied.

All purchased accessory items will remain as coated by the original manufacturers.

Approximate Physical Data (Horizontal Helical Coil Heater Only):

33.4' L x 9.2' W' x 10'H (Less Stack)	
Dry Weight 30,000 Lbs.	

Should a purchase order be awarded to Heatec, only those specifications included with original Inquiry (RFQ, etc.) are considered valid. Any additional or different specifications included in the body of the purchase order, attached to, or otherwise included with said purchase order, when reviewed, may provide grounds for possible additional pricing and/or design changes, as well as possible delivery changes.

INVESTMENT:

The investment required for the items listed above is as follows (Prices are F.O.B. Heatec).

HCI 10010-40(D) Heater, controls, pumps, expansion tank and valving and piping	

All costs are FOB Chattanooga, TN. Plant site.
These costs are valid for sixty (90) days. This cost does not need to be paid in one lump sum.

10

Williams, Jerry

From: Williams, Jerry
Sent: Friday, December 30, 2016 8:13 AM
To: 'wade.janecek@markwest.com'; 'lmeyer@markwest.com'
Cc: McKeone, Beverly D
Subject: WV DAQ Permit Application Incomplete for MarkWest Liberty Midstream & Resources, LLC - Majorsville Gas Plant (Additional request)

Upon further review of the permit application, the following items also need addressed in addition to the 12/29/2016 incomplete email in order for the permit application to be deemed complete:

1. Please provide GHG (CO2e) calculations for all emission sources.
2. The annual formaldehyde emissions provided for C-102, 103, 104 appear to have an annual operating limitation of 6,172 hours. Please address.
3. The hourly and annual VOC emissions for C-102, 103, 104 are different than what is currently permitted. Please provide emission calculations for all criteria pollutants, HAPs, and GHG for these engines.
4. Attachment I lists Emission Unit ID H-2741 twice. It is listed as emission point 9E and 24E. Please address.
5. Attachment N (Emission Calculations) state in multiple places that NOx, CO, PM, and VOC emissions from heaters (H-1741, 2741, 3741, 4741, 5741, 6741, 7741, 3781, 4781, 7781, 1782, 2782) are from vendor guarantees. Please provide the vendor guarantees for these heaters.
6. Please provide emission calculations for heaters H-741, 781, 4782.
7. Please provide emission calculations for flares F-991, 3991.

Please address the above deficiencies in writing within fifteen (15) days of the receipt of this email. Application review will not commence until the application has been deemed to be technically complete. Failure to respond to this request in a timely manner may result in the denial of the application.

Should you have any questions, please contact Jerry Williams at (304) 926-0499 ext. 1223 or reply to this email.

From: Williams, Jerry
Sent: Thursday, December 29, 2016 8:05 AM
To: 'lmeyer@markwest.com' <lmeyer@markwest.com>; 'wade.janecek@markwest.com' <wade.janecek@markwest.com>
Cc: McKeone, Beverly D <Beverly.D.Mckeone@wv.gov>
Subject: WV DAQ Permit Application Incomplete for MarkWest Liberty Midstream & Resources, LLC - Majorsville Gas Plant

RE: Application Status: Incomplete
MarkWest Liberty Midstream & Resources, LLC - Majorsville Gas Plant
Permit Application No. R13-2818G
Plant ID No. 051-00125

ID # 051-00125
Reg 13-2818G
Company MARKWEST
Facility MAJORSVILLE Initials JW

Ms. Meyer,

Your application for a modification permit for a natural gas processing facility was received by this Division on December 8, 2016 and assigned to the writer for review. Upon initial review of said application, it has been determined that the application as submitted is incomplete based on the following items:

1. Failure to submit affidavit of publication for Class I legal advertisement.

NON-CONFIDENTIAL

2. SIC Code 1311, provided in this permit application is different from the previous permit. The previous permit utilized 1321 which is for natural gas liquid extraction. Please confirm the correct SIC/NAICS code.
3. This permit application indicates there are eight (8) existing emergency generators. However, there are only two (2) emergency generators in your current permit. Please explain the discrepancy.
4. The emission point IDs utilized in your current application (specifically Attachment I) do not match what is used in your current permit. Please explain the discrepancy.
5. Please provide all pigging and blowdown emissions associated with this facility. This shall include number of annual events and gas released per event (scf/event).
6. Attachment L for LDAR only referenced Subpart KKK and OOOO. Is Majorsville VIII subject to OOOOa?
7. Please provide clarification on the emergency generator manufacturer's data sheets as to which manufacturer data sheets correlate with the proper emergency generator ID#s.
8. The permit application provided no emission data for any of the storage tanks. Please provide this information.
9. Please provide a source aggregation analysis.

Please address the above deficiencies in writing within fifteen (15) days of the receipt of this email. Application review will not commence until the application has been deemed to be technically complete. Failure to respond to this request in a timely manner may result in the denial of the application.

Should you have any questions, please contact Jerry Williams at (304) 926-0499 ext. 1223 or reply to this email.

Williams, Jerry

From: Williams, Jerry
Sent: Thursday, December 29, 2016 8:05 AM
To: 'lmeyer@markwest.com'; 'wade.janecek@markwest.com'
Cc: McKeone, Beverly D
Subject: WV DAQ Permit Application Incomplete for MarkWest Liberty Midstream & Resources, LLC - Majorsville Gas Plant

RE: Application Status: Incomplete
MarkWest Liberty Midstream & Resources, LLC - Majorsville Gas Plant
Permit Application No. R13-2818G
Plant ID No. 051-00125

Ms. Meyer,

Your application for a modification permit for a natural gas processing facility was received by this Division on December 8, 2016 and assigned to the writer for review. Upon initial review of said application, it has been determined that the application as submitted is incomplete based on the following items:

1. Failure to submit affidavit of publication for Class I legal advertisement.
2. SIC Code 1311, provided in this permit application is different from the previous permit. The previous permit utilized 1321 which is for natural gas liquid extraction. Please confirm the correct SIC/NAICS code.
3. This permit application indicates there are eight (8) existing emergency generators. However, there are only two (2) emergency generators in your current permit. Please explain the discrepancy.
4. The emission point IDs utilized in your current application (specifically Attachment I) do not match what is used in your current permit. Please explain the discrepancy.
5. Please provide all pigging and blowdown emissions associated with this facility. This shall include number of annual events and gas released per event (scf/event).
6. Attachment L for LDAR only referenced Subpart KKK and OOOO. Is Majorsville VIII subject to OOOOa?
7. Please provide clarification on the emergency generator manufacturer's data sheets as to which manufacturer data sheets correlate with the proper emergency generator ID#s.
8. The permit application provided no emission data for any of the storage tanks. Please provide this information.
9. Please provide a source aggregation analysis.

Please address the above deficiencies in writing within fifteen (15) days of the receipt of this email. Application review will not commence until the application has been deemed to be technically complete. Failure to respond to this request in a timely manner may result in the denial of the application.

Should you have any questions, please contact Jerry Williams at (304) 926-0499 ext. 1223 or reply to this email.

Williams, Jerry

From: Ward, Beth A
Sent: Friday, December 9, 2016 2:15 PM
To: Williams, Jerry
Subject: MARKWEST LIBERTY MIDSTREAM & RESOURCES LLC PERMIT APPLICATION FEE

This is the receipt for payment received from:

MARKWEST LIBERTY MIDSTREAM & RESOURCES LLC, MAJORSVILLE, CHECK NUMBER 13809, CHECK DATE 11/02/2016, $2,000.00
R13-2818G ID# 051-00125

OASIS CR 1700062766

THANK YOU!

Beth Ward

WV DEPARTMENT OF ENVIRONMENTAL PROTECTION
BTO FISCAL
601 57TH STREET SE
CHARLESTON, WV 25304
(304) 926-0499 EXT 1846
beth.a.ward@wv.gov

NON-CONFIDENTIAL

Adkins, Sandra K

From:	Adkins, Sandra K
Sent:	Friday, December 9, 2016 11:29 AM
To:	'lmeyer@markwest.com'; 'wade.janecek@markwest.com'
Cc:	McKeone, Beverly D; Williams, Jerry
Subject:	WV DAQ Permit Application Status for MarkWest Liberty Midstream & Resources, LLC; Majorsville

RE: Application Status
MarkWest Liberty Midstream & Resources, LLC
Majorsville
Facility ID No. 051-00125
Application No. R13-2818G

Leanne Meyer,

Your application for a modification permit for the Majorsville Gas Plant was received by this Division on December 8, 2016, and was assigned to Jerry Williams. The following item was not included in the initial application submittal:

Original affidavit for Class I legal advertisement not submitted.
Please use telephone extension 1250 in legal advertisements.

This item is necessary for the assigned permit writer to continue the 30-day completeness review.

Within 30 days, you should receive a letter from Jerry stating the status of the permit application and, if complete, given an estimated time frame for the agency's final action on the permit.

Any determination of completeness shall not relieve the permit applicant of the requirement to subsequently submit, in a timely manner, any additional or corrected information deemed necessary for a final permit decision.

In the future, please submit one original and two electronic versions of the application. Electronic versions should contain signatures. Copies of checks are not needed and should not be included in electronic copies.

Should you have any questions, please contact the assigned engineer, Jerry Williams, at 304-926-0499, extension 1223.

R13-2818G modification
051-00125

45CSR13 Administrative Update, Construction, Modification, Relocation, Temporary Permit or General Permit Registration Incomplete Application

A complete application is demonstrated when all of the information required below is properly prepared, completed and attached. The items listed below are required information which must be submitted with a 45CSR13 permit application. Any submittal will be considered incomplete if the required information is not included. The applicant must submit a complete application in order to receive a 45CSR13 permit.

☒ Class I legal advertisement not published in a newspaper certified to accept legal advertisements and original affidavit submitted. X1250

☐ Application fee AND/OR additional application fees not included:
- ☐ $250 Class I General Permit
- ☐ $300 Class II Administrative Update
- ☐ $1,000 Construction, Modification, Relocation or Temporary Permit
- ☐ $500 Class II General Permit
- ☐ $1,000 NSPS
- ☐ $2,500 NESHAP
- ☐ $2,500 45CSR27 Pollutant
- ☐ $5,000 Major Modification
- ☐ $10,000 Major Construction

☒ Original and two (2) copies of the application not submitted. 2CD in future – NO copies of this are needed

☐ File organization – application pages are not numbered or in correct order, application is not bound in some way, etc.

☐ Confidential Business Information is not properly identified.

☐ General application forms not completed and signed by a responsible official.

☐ Authority of Corporation form not included – required if application is signed by someone other than a responsible official.

☐ Applicant is not registered with the West Virginia Secretary of State's Office.

☐ Copy of current Business Registration Certificate not included.

☐ Process description, including equipment and emission point identification numbers, not submitted.

☐ Process flow diagram, including equipment and emission point identification numbers, not submitted.

☐ Plot plan, including equipment and emission point identification numbers, not submitted.

☐ Applicable technical forms not completed and submitted:

- ☐ Emission Point Data Summary Sheets
- ☐ Air Pollution Control Device Sheets
- ☐ Emission Unit Data Sheets
- ☐ Equipment List Form

☐ Emission calculations not included – emission factors, references, source identification numbers, etc.

☐ Electronic submittal diskette not included.